XT Racing

GPX PRO

User Manual

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GPX Pro Manual

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1 GPX Pro

The GPX is a GPS-based timer and data acquisition component that operates in one of four modes: Circuit Racing, Point-to-Point Racing, Drag Racing, and Instrument Cluster.

<u>Circuit Racing</u> mode is for tracks on which you run multiple laps – circle tracks, oval tracks, road racing tracks, etc. There is a start/finish line which you cross multiple times, and detailed lap information is stored for each lap. Up to 5 split points may be defined.

<u>Point-to-Point Racing</u> mode is for races that start at a starting point and end at a finishing point – rally races, for example. Up to 5 split points may be defined.

<u>Drag Racing</u> mode allows you to perform a "drag session" and record data for that session. A number of different types of drag modes are supported – ¼ mile, 1/8 mile, 1 mile; 0-30, 0-60, 0-100 mph; 0-30-0, 0-60-0, 0-100-0 mph; and a roll-on mode which times and measures from a programmable start speed to a programmable stop speed (for example, 60-100 mph).

<u>Instrument Cluster</u> mode provides a "dashboard" for your vehicle when you are not racing.

Without any external connections, timing and speed information, track maps, and acceleration data are available directly from the GPS and built-in accelerometers. By connecting the GPX to appropriate wires and sensors from your vehicle, you may store and analyze additional data: for example, RPM, gear, engine temperature, and suspension travel. By using GPStudio, the accompanying Windows application software, you can analyze in detail all of this information, as well as completely customize the appearance and data displays of the GPX itself.

1.1 Circuit Racing Mode

<u>Circuit Racing</u> mode is for tracks on which you run multiple laps – circle tracks, oval tracks, road racing tracks, etc. There is a start/finish line which you cross multiple times, and detailed lap information is stored for each lap. Up to 5 split points may be defined.

1.1.1 Basic Operation

Fresh out of the box, the GPX is configured in Circuit Racing mode and is ready to go. Turn on the GPX by pressing the <u>Menu</u> button and you should see the main Circuit Racing screen:
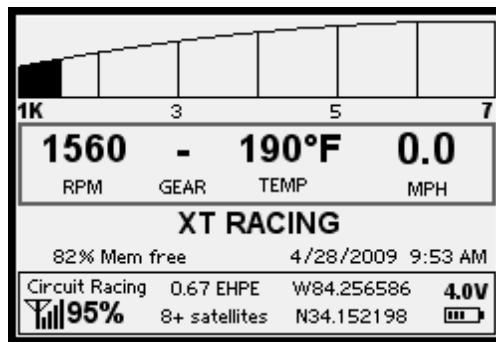
> NOTE: if the GPX does not power up by pressing any button, try pressing all four buttons simultaneously. If this does not power up the GPX, then the internal rechargeable battery is probably discharged and will need to be charged.

The GPX needs to acquire a good signal from at least 4 GPS satellites, and an EHPE (estimated horizontal position error) of less than 5.00. You can see the status of the GPS signals in the lower left corner of the main screen. You might find that you get better reception by moving the mounting position of the GPX in your vehicle. The internal antenna is positioned above the 4-way switch. Please note that you can purchase an optional external antenna that will allow placing the antenna separate from the GPX and often can provide better reception.

If the GPX has been powered off for less than 2 hours, then when you power up the GPX, good signal acquisition should occur within a few seconds (depending on "view of the sky"). If the GPX has been powered off for more than 2 hours, signal acquisition can take as long as several minutes.

> **NOTE: the GPX must be on the main screen (above) when you start a Circuit race.**

Once you have acquired a good signal, you can start racing. Out of the box, the GPX will not start operating until you reach a speed of 50 miles per hour (this is adjustable via the menu system). This will prevent capturing lots of "garbage" data while driving/riding through the pits. Once you hit your starting speed, you will notice that the GPX switches to the "spinner" screen:
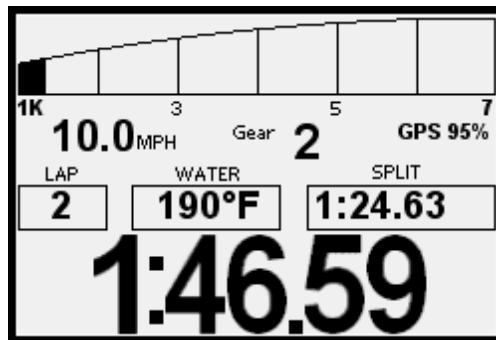
This screen will be the screen shown during the entire race.

> If this is the ***first time you have raced at this track***, the device will automatically determine that you have completed a circuit and will start timing once it has determined the geometry of the track.

> If you have ***raced at this track before***, as soon as you cross the start/finish line, the GPX will recognize the track and start timing laps immediately.

Lap times will be "held" at the end of each screen for 10 seconds (menu adjustable).

When you slow down to under 5 mph (menu adjustable), the GPX will stop acquiring data for that session and will ask you to name the new track you have just raced:

```
New track detected
  - enter name



ALPHA_GP_____
          ^
```
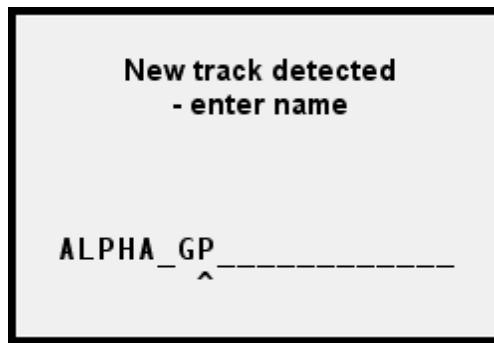
If you just hit **Menu** at this point, it will use the name suggested (NEW TRACK 1) as the track name. If you would like to name the track otherwise, press the **Left** and **Right** arrow buttons to cycle through letters/numbers/space. Press **Select** to go to the next character position, and use the arrow buttons again. When you are done entering the track name, press **Menu** and you will go back to the main screen.

> NOTE: you can "back up" to the previous character position by pressing **Select** when a "left arrow" shows as you're cycling through the letters and numbers

Race again, and the whole process will start over.

Reviewing laps in Circuit Racing Mode

From the main screen, press the **Left** arrow to go to the first session stored in the GPX, or the **Right** arrow to go to the most recently captured session. This will show a summary screen for that session:
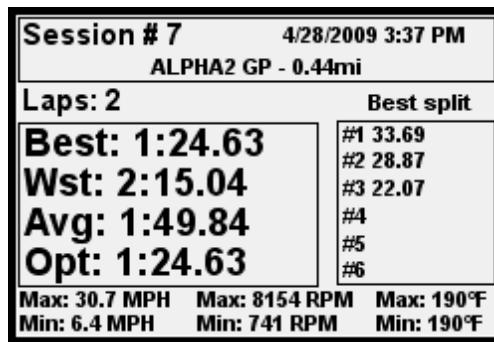
You move from session to session by pressing **Left** and **Right** as desired. You can at this point also press **Menu** to return to the main screen.

To review the laps for a session, press **Select** from that summary screen and you will see the lap detail:
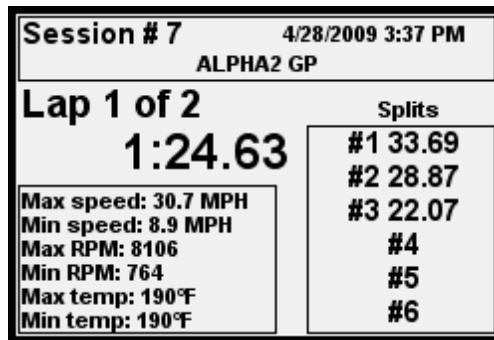
Press the **Left** and **Right** arrow button to cycle through the laps for that session. Press **Menu** to return to the summary screen for that session. To see the track map for a lap, press **Select**:
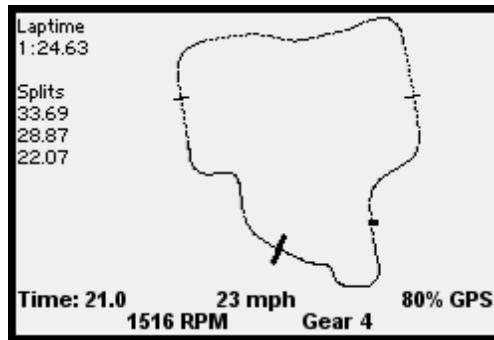
On the track map screen, the dot will start moving around the track. On the bottom of the screen, you will see the speed, time, and GPS signal strength; RPM and gear will also be shown if captured via data acquisition.

To stop the moving dot, press the **Left** or **Right** arrow button. Then pressing the **Left** or **Right** button will move the dot a little bit around the track.

To return to the lap detail, press **Menu**.

1.1.2 More Details

Lap Counter operation

The lap counter, if used, can count either up or down. Initially, before any laps have started, it displays "-". If set for counting up, then at the beginning of the first lap it will display "1", and "1" will continue to be displayed during the hold time. It will keep counting up, no matter what the setting for "number of laps".

If set for counting down (say the number of laps is 5), then it will display "5" during the first lap and its hold time, and will decrease by one each lap. When that number of laps is complete, the lap display will revert to "-".

Tracks

The GPX automatically determines if you race at a new track that it has not yet encountered, or if you are at a track that you have been to before. It does this by monitoring the size and shape of the track's "loop" and either matching it to a track that is stored in its memory, or else creating a new track.

Example: You go to a new track for the first time, and start racing. Once you have completed a "loop", the GPX determines that you are at a new track. It records your session, and when it is done, it will default the track name to something like "NEW TRACK 1", and you may then change the name to the track's actual name.

Start/Finish Line

Each track layout in the GPX has a start/finish line associated with it. (In actuality, it is a start/ finish "point"). The start-finish line is that point on the track at which a line across the track goes through that point.

The simplest way to get a start/finish line at a new track is to do nothing. Race around the track, and the GPX will find the "loop" point and use it for the start/finish line.

There are two modes for having the GPX determine the start/finish line (menu item **Track detection method**). **First loop** (the default) is just that – the GPX determines the first time a loop is "closed" and makes that point the start/finish line**. Longest straight** requires an additional 1-2 loops around the track, and in this case the GPX sets the start/finish line about one-third of the way down the "longest straightaway". (The straightaway that the GPX calculates allows for some slight variation from a straight line]

The other way to set a start/finish at a new track is to walk over to near where you want the start/ finish line to be, and set the start/finish line via the GPX's menu system (**Track options**, **Set start/ finish line of a new track**). This point will now form the basis for the start/finish line when you start racing the track. Please note that you should be no more than about 50 feet of where your vehicle will cross the start/finish line in order for the GPX to recognize it while you are racing.

At any time, you may move the start/finish line for a track via the menu system. Please note that when you move the start/finish line, it will apply to all sessions/laps stored in the GPX, and therefore the lap and split times will be recalculated for each session at that track. When you see the message "Recreating summary information – please wait", this is due to the recalculation necessary when moving start/finish line or splits.

Under unusual circumstances, you may need to use manual track selection as opposed to the automatic methods. See the section **Manual Track Selection**.

Adding Splits, or Changing the Start/Finish Line

For an existing track, you can either move the start/finish line, add split points, or remove split points.

In the menu system, go to **Track options**, then **Change start-finish or maintain splits**. You will now be allowed to select from the available tracks. Pick a track using the **Left** and **Right** arrows, then **Select**. Then choose whether to move the start/finish, add a split, or remove all splits. If you move the start/finish or add a split, you will see an animated dot moving around the track. To stop it near where you want, press either arrow to stop it. Then you may press **Left** or **Right** to fine-tune the position. When you are happy with the position, press **Select**. You may press **Menu** to abort the operation.

Whenever you modify the start/finish line or splits, the lap times and all summary information for each session at that track will need to be recalculated. That calculation will occur when you view a session at that track. You will a message stating

> Recreating summary information -- please wait, and do not power down...

This indicates that the recalculation is taking place. It generally only takes a few seconds.

Track Variation -- Clockwise vs. Counter-Clockwise

First, assume that you are letting the GPX initially determine the start/finish automatically. Also assume the first time you race this track, you do it "clockwise". The GPX will determine the start/ finish, and at the end of the session, you will rename the track from "NEW TRACK 1" to "MYTRACK CW". Now, the next time you go to the track, you start racing, but you race in the other direction. GPX will determine that you pass by the same start/finish line, but it detects that you are going in

the opposite direction – so at the end of that session, it will prompt you for a new track like "NEW TRACK 2" and you can then change it to "MYTRACK CCW". As far as GPX is concerned, these are two different tracks. Each time you race from now on, it will determine which direction you are racing, and pick the correct track accordingly.

If you create the start/finish point manually via the menu system before racing for the first time, it works identically – the first time you race, after the session is over, name the track appropriately (e.g., "CW" or "CCW"). Then, just like above, when you next race in the opposite direction, you will be prompted at the end of that session for a new name, and there will be two track layouts.

1.1.3   Manual Track Selection

For multiple track configurations at the same track, you may need to use manual track selection to properly select the configuration.

We will use VIR as an example (**http://www.virnow.com/**). Let's say sometimes you run the South course, and sometimes the Full course. They share the start/finish line, so the GPX is unable to detect which one is which.

In this case, select menu item **Track options**, then **Set start/finish line of a new track**, go to the start/finish line, and name it VIR SOUTH. While you are still there, **Set start/finish line of a new track**, and name it VIR FULL. The GPX now has two tracks in its memory, both of which have the same start/finish line.

Now, whenever you race at VIR, go to **Track options**, **Track detection method**, **Manual selection**. Then select either VIR SOUTH or VIR FULL. Now, when you start racing, when you cross the start/ finish line, the GPX will select the correct track.

As long as you race the same course (for example, that race day), the track you selected will remain selected -- until you change the track selection either manually or with one of the automatic detection methods.

1.1.4   Endurance Racing and Pit Stops

For "normal" circuit racing, when you go below the stopping speed, the session in the GPX ends. That is typically the way a race ends.

However, if you are doing endurance racing, or you are doing testing where you stop for a little while and then keep right on going, you might not want to have the GPX keep creating new sessions each time you stop.

In this case, you can set the GPX to allow you to come to a stop and still keep recording as part of the same session when you resume. To do this, go to **Set stopping speed/time**, and **Choose stopping method** as **Stop based on time**. Then enter the number of minutes (maximum) that you would like the GPX to keep active until you restart. Only when you exceed that number of minutes, or press any button, will the session end. Note that you still need to set the stopping

speed so the GPX knows when to start keeping track of the amount of time you are "stopped".

1.1.5 Menus

Set starting speed – the speed at which the GPX starts capturing data for circuit racing

Set stopping speed/time – how the GPX terminates capturing data for a session

Choose stopping method

Stop based on speed - the GPX stops capturing when you go below this speed

Stop based on time - the GPX stops capturing this many minutes after you go below the "stop based on speed" speed (or when you press any key when stopped)

Spinner options

Count laps

Count up – the lap counter starts at one and increases

Count down – the lap counter start at the specified count (see below) and counts down

Set number of laps per session – used for "Count down"

Hold time at end of each lap – number of seconds your lap time will "freeze" on the display at the end of each lap

Split hold time – number of seconds each split time will "freeze" on the display when you pass the split

Track options

Track detection method

First loop – a new track will be detected as soon as a complete loop is detected and the start/finish line will be set at that point

Longest straight – a new track will be detected as soon as a complete loop is detected, but the start/finish line will be set 1-2 laps later, about 1/3 of the way down the longest straightaway

Manual selection - you select via a menu which track you are racing at

Set the start/finish line of a new track – allows you to manually "create a new track" by physically going to the start/finish line to register the GPS coordinate

Change start/finish

(select a track) - allows you to move the start/finish line

Maintain splits

(select a track)

Add split – adds a new split for this track. There is a limit of 5 splits.

Remove a split – removes the selected split (a little box indicates which split will be removed when you press **Select**)

Remove all splits – deletes all the splits

Rename a track – change the name of an existing track

Data acquisition setup and parameters

For detailed information, see the section **Data Acquisition (DAQ**)

Tachometer options – controls how the tach lights and tach bar during races will be utilized

Tach style – how the 8 LEDS will be utilized

Off – lights will not be used for anything

1 LED at a time – only one LED lights up at a time

All LEDs – more LEDs light up at increasing RPMs (consumes more battery power!)

Thumbs up/down – lights are not used for RPM. In Circuit racing, if you do a faster lap than the previous, the green lights will blink; if a slower lap, the red lights will blink.

Tach brightness – a setting from 1-10 of increasing brightness of the tach lights

Tach RPM Green – the RPM that the green LEDs come on

Tach RPM Yellow – the RPM at which the yellow LEDs start coming on

Tach RPM Red – The RPM at which the red LEDS start coming on

Tach RPM white (shift light) – the "redline"

Shift light style - what happens when you exceed the "redline"

White LEDs blink

White LEDs solid

All LEDs blink

Tach Display Minimum RPM – this is the minimum RPM on the Tach that displays on the LCD graph

Tach Display Maximum RPM – this is the maximum RPM on the Tach that displays on the LCD graph

LCD Display Options

Backlight on/off control – control over the LCD panel backlight

Off – no backlight

On Activity – turns on for about 10 seconds after every keypress, and lap or split completed

Always ON – always on (consumes more battery power!)

Backlight brightness – a value from 1-10 controlling the brightness (higher values use more battery power!)

LCD contrast – adjusts the contrast of the LCD panel

Normal or reverse display

Normal display – Black characters on a white background

Reverse display – White characters on a black background

Power-Off Options

Power off now -- selecting this immediately turns off the GPX

Minutes until auto power off – after this many minutes of no activity, the GPX will turn off

File Maintenance

Delete last viewed session (for deleting the last session you viewed in the GPX)

(confirmation required)

Delete a track and its sessions - see section on **File Maintenance**

(confirmation required)

Delete all sessions for a track -- see section on **File Maintenance**

(confirmation required)

Delete all session -- see section on **File Maintenance**

(confirmation required)

Delete all tracks and sessions -- see section on **File Maintenance**

(confirmation required)

File system check – checks the integrity of the GPX's built-in file system

Display Formats and Units

Time Format – specifies how times will be displayed

16:26 style

4:26 PM style

Date format – specifies how dates will be displayed

4/23/2008 – month/day/year

2008/04/23 – year/month day

RPM format – specifies how RPMs will be displayed

11200 – full value

11.2K – in K

Miles per hour or kilometers per hour

MPH – distances and speeds based on miles

KPH – distances and speeds based on kilometers

Fahrenheit or Celsius -- specify the temperature scale

Fahrenheit

Celsius

Latitude/longitude format - display and data entry method for coordinates

N34 13.7326 -- degrees, minutes, fractional minutes

N34.228877 -- degrees, fractional degrees

Miscellaneous

Odometer/hour meters

Show distance/time meters -- displays their current values

Clear distance/time meter 1

Clear distance/time meter 2

Set local time – sets the local time as a variation from UTC (Greenwhich Mean Time)

Personalization -- owner information

Set personalization line 1

Set personalization line 2

Clear personalization line 1

Clear personalization line 2

Show Version Information – displays information about the GPX software version

Reset settings to factory default – resets all settings. Does *not* delete sessions or tracks.

(confirmation required)

Device mode and profiles

Device mode - changes the basic racing mode of the GPX

Circuit Racing – races that occur repetitively over the same course (circle, oval, road racing)

Point-to-Point Racing – racing from a start point to a finish point (rally)

Drag racing – 0-60, 0-60-0, ¼ mile, etc.

Instrument Cluster – a "dashboard"

Switch to another profile - switch to another vehicle's inputs/settings/calibrations

1.2   **Point-to-Point Racing Mode**

Point-to-Point Racing mode is for races that start at a starting point and end at a finishing point – rally races, for example. Up to 5 split points may be defined.

1.2.1   Basic Operation

Unlike Circuit Mode, in Point-to-Point mode, the GPX cannot determine the start and finish for the race. You must "create" a new track, then define the start and finish point. (And optionally define split points.)

To "create" the new track, go into the menu system, go to **Track Options**, then press **Select**. Using the arrows, go to **Create a new track**, and press **Select**. Enter the name of the new track using arrows and **Select**. Press **Menu** when the name is complete.

Now, physically go to the starting point of the race. On the main screen, make sure you have a good GPS signal (4 or more satellites, less than 5.00 EHPE). Go into the menu system, go to Track Options, and using the arrows go to **Set start point**. Press **Select**. You will now choose the track using the arrows (if you only have one point-to-point track in the GPX, it will be shown with no left or right arrow showing). Press **Select** on that track. Make sure you are at the starting point, and press Select. After a few seconds, the GPS information will be recorded, and it will return to the menu system.

Do the same procedure for the finish of the race by going to **Set finish point** and following the same steps.

Do the same if you want to enter any split points for the race. Please note that you do not have to set the start point before you set the finish point – you may define the start/finish/split points in any convenient order.

Notice that on the menus, a check mark is displayed next to each point which you have defined:

```
Track options
  Set start/finish/splits
    Coordinates via GPS capture
    OFF HOME
      √Set start point
      √Set finish point
      Set split # 1 point
      Set split # 2 point
      Set split # 3 point
      Set split # 4 point
      Set split # 5 point
```
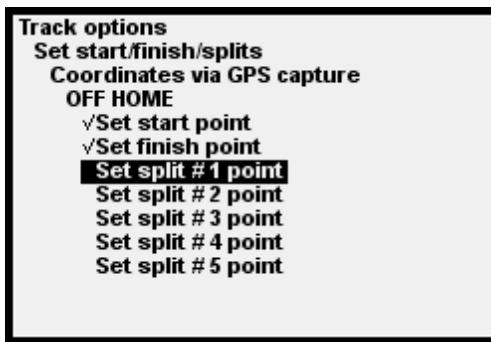
To start the race, go into the menu system, go to Select a track to start race, and select the track.

There are two methods to start a point-to-point race --**Standing start** and **Running start**. Use standing start when a race starter starts you. (For standing start, the "start point" of the race is not actually used -- it assumes you are starting from the correct spot.) For a standing start, the accelerometers must "zero" themselves, which takes a few seconds when you select the track to start the race. Zeroing of the accelerometers allows the GPX to determine the precise instant

when you start your motion and starts timing from that point in time.

If you choose "running start", then you must approach the start point going at least 5 mph. When you pass the start point, the timing of the race starts, and the "spinner screen" displays.

To start a point-to-point race, first position yourself to start the race. Then, from the main screen press **Menu** and go to **Select a track to start a race**. Press **Select**. Pick the track name, press **Select** to select that track, and start racing. As soon as you pass the start point, the GPX will begin timing and acquiring data:
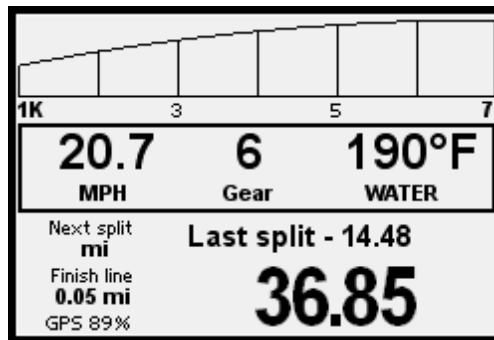
When the race is over, the summary screen for that race will automatically be shown:
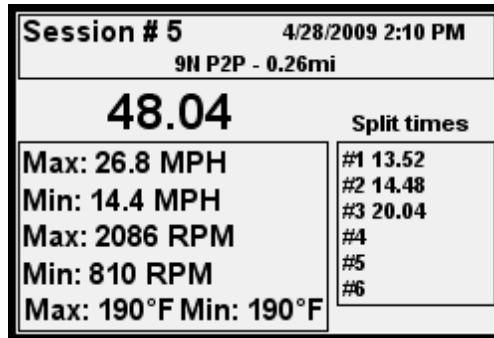
To review your point-to-point races, from the main screen, press **Left** and **Right** to cycle through the races. Press **Menu** to return to the main screen.

1.2.2 More Details

Direct entry of start/finish/split coordinates

There is another method of entering the points for a point-to-point track -- direct entry of GPS coordinates. To do this, you must obtain the latitude and longitude of the points. For example, the website http://itouchmap.com/latlong.html is one such source.

There are two common formats for latitude/longitude -- degree/minute/fractional minute, and degree/fractional degree. You can, through the menu selection "Display formats and units",

select which one you will use. (For example, the above website reports coordinates in the degree/fractional degree format.)

For latitude, positive numbers are NORTH and negative numbers are SOUTH. For longitude, positive numbers are EAST and negative numbers are WEST. When entering coordinates manually, the GPS requires N/S and E/W.

If a coordinate contains more decimal points than the GPX can handle, you can safely ignore the extra digits.

Use the **Left** and **Right** arrows to change each position of data entry, and press **Select** to go to the next position. Press **Menu** when complete.

Example of coordinate entry using degree/fractional degree:

```
┌─────────────────────────────┐
│     ┌─────────────────┐      │
│     │ Set split # 1 point │  │
│     └─────────────────┘      │
│                             │
│                             │
│   N34.151976  W084.253193   │
│            ^                │
└─────────────────────────────┘
```
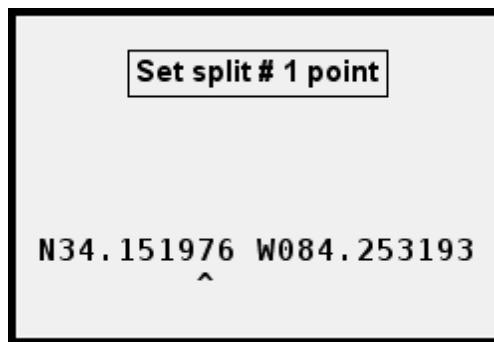
Example of coordinate entry using degree/minute/fractional minute:

```
┌─────────────────────────────┐
│     ┌─────────────────┐      │
│     │ Set split # 1 point │  │
│     └─────────────────┘      │
│                             │
│                             │
│   N34°09.1186  W084°15.1916 │
│           ^                 │
└─────────────────────────────┘
```
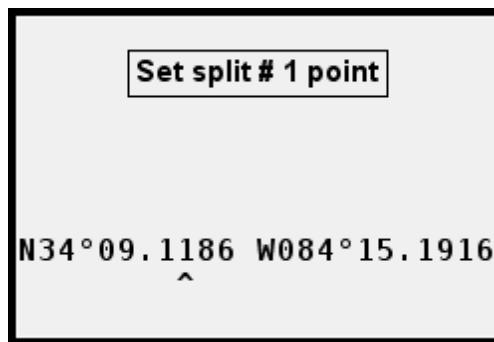
Distance to next split and finish

The default spinner screen for point-to-point shows the distance to the next split, and the distance to the finish. These are straight-line distances "as the crow flies".

Accelerometer sensitivity

Depending on the mounting of the GPX and the amount of vehicle vibration, you may need to

adjust the acceleration sensitivity when doing a standing start. The menu item **Acceleration sensitivity** allows you to change it. **High** sensitivity means the GPX will be most sensitive to the slightest movement; **Low** means the GPX will be more lenient to vibration.

```
Acceleration sensitivity
  Low
  Medium
  Normal
  High
```
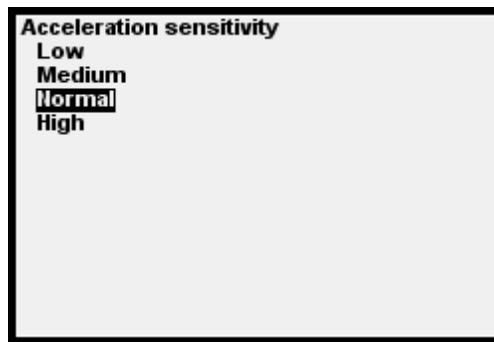
If you find that the GPX starts timing a standing start before you start your vehicle, change the sensitivity to a lower setting.

1.2.3   Menus

Select a track to start a race

> **(select from list of tracks)** - when you select the track, the race is ready to start

Race start method

> **Running start** - you start behind the starting line and "fly by" the start line

> **Standing start** - a race "starter" starts you. Timing starts when the vehicle goes in motion

Acceleration sensitivity - adjust how sensitive standing-start detection is

> **Low**

> **Medium**

> **Normal**

> **High**

Track options

> **Create a new track** - enter the name of a new track

> **Set start/finish/splits**

>> **Coordinates via GPS capture** - go to the spot and record GPS coordinates

(select from list of tracks)

Set start point

Set finish point

Set split # 1 point

...

Set split # 5 point

Coordinates via keypad entry - enter known latitude and longitude

(select from list of tracks)

Set start point

Set finish point

Set split # 1 point

...

Set split # 5 point

Rename a track

(select from list of tracks)

Data acquisition setup and parameters

For detailed information, see the section **Data Acquisition (DAQ)**

Tachometer options – controls how the tach lights and tach bar during races will be utilized

Tach style – how the 8 LEDS will be utilized

Off – lights will not be used for anything

1 LED at a time – only one LED lights up at a time

All LEDs – more LEDs light up at increasing RPMs (consumes more battery power!)

Thumbs up/down – lights will not come on in point-to-point mode

Tach brightness – a setting from 1-10 of increasing brightness of the tach lights

Tach RPM Green – the RPM that the green LEDs come on

Tach Yellow – the RPM at which the yellow LEDs start coming on

Tach Red – The RPM at which the red LEDS start coming on

Tach RPM white (shift light) – the "redline"

Shift light style - what happens when you exceed the "redline"

> **White LEDs blink**

> **White LEDs solid**

> **All LEDs blink**

Tach Display Minimum RPM – this is the minimum RPM on the Tach that displays on the LCD graph

Tach Display Maximum RPM – this is the maximum RPM on the Tach that displays on the LCD graph

LCD Display Options

Backlight on/off control – control over the LCD panel backlight

> **Off** – no backlight

> **On Activity** – turns on for about 10 seconds after every keypress, and lap or split completed

> **Always ON** – always on (consumes more battery power!)

Backlight brightness – a value from 1-10 controlling the brightness (higher values use more battery power!)

LCD contrast – adjusts the contrast of the LCD panel

Normal or reverse display

> **Normal display** – Black characters on a white background

> **Reverse display** – White characters on a black background

Power-Off Options

Power off now -- selecting this immediately turns off the GPX

Minutes until auto power off – after this many minutes of no activity, the GPX will turn off

File Maintenance

Delete last viewed session (for deleting the last session you viewed in the GPX)

(confirmation required)

Delete a track and its sessions - see section on **File Maintenance**

(confirmation required)

Delete all sessions for a track -- see section on **File Maintenance**

(confirmation required)

Delete all session -- see section on **File Maintenance**

(confirmation required)

Delete all tracks and sessions -- see section on **File Maintenance**

(confirmation required)

File system check – checks the integrity of the GPX's built-in file system

Display Formats and Units

Time Format – specifies how times will be displayed

16:26 style

4:26 PM style

Date format – specifies how dates will be displayed

4/23/2008 – month/day/year

2008/04/23 – year/month dayt

RPM format – specifies how RPMs will be displayed

11200 – full value

11.2K – in K

Miles per hour or kilometers per hour

MPH – distances and speeds based on miles

KPH – distances and speeds based on kilometers

Fahrenheit or Celsius -- specify the temperature scale

Fahrenheit

Celsius

Latitude/longitude format - display and data entry method for coordinates

N34 13.7326 -- degrees, minutes, fractional minutes

N34.228877 -- degrees, fractional degrees

Miscellaneous

Odometer/hour meters

Show distance/time meters -- displays their current values

Clear distance/time meter 1

Clear distance/time meter 2

Set local time – sets the local time as a variation from UTC (Greenwhich Mean Time)

Personalization -- owner information

Set personalization line 1

Set personalization line 2

Clear personalization line 1

Clear personalization line 2

Show Version Information – displays information about the GPX software version

Reset settings to factory default – resets all settings. Does *not* delete sessions or tracks.

(confirmation required)

Device mode and profiles

Device mode - changes the basic racing mode of the GPX

Circuit Racing – races that occur repetitively over the same course (circle, oval, road racing)

Point-to-Point Racing – racing from a start point to a finish point (rally)

Drag racing – 0-60, 0-60-0, ¼ mile, etc.

Instrument Cluster – a "dashboard"

> <u>**Switch to another profile**</u> - switch to another vehicle's inputs/settings/calibrations

1.3 Drag Racing Mode

<u>Drag Racing</u> mode allows you to perform a "drag session" and record data for that session. A number of different types of drag modes are supported – ¼ mile, 1/8 mile, 1 mile; 0-30, 0-60, 0-100 mph; 0-30-0, 0-60-0, 0-100-0 mph; and a roll-on mode which times and measures from a programmable start speed to a programmable stop speed (for example, 60-100 mph).

1.3.1 Basic Operation

In Drag Racing mode, you can select from the following types of drag race via the menu item **Type of drag race**:

> 1/8 mile; ¼ mile; 1 mile
>
> 0-30 mph; 0-60 mph; 0-100 mph
>
> 0-30-0 mph; 0-60-0 mph; 0-100-0 mph
>
> "Roll-on" (e.g., 60-100 mph)

In addition, for each race type (except roll-on), you can select how you will start the session via the menu item **Drag race starting method**: "Standing Start" (timing starts whenever the vehicle starts moving), or "Tree lights" (you start after a brief cycling of red to yellow to green) and the reaction time is recorded. There is no "track" for drag racing. You can do it anywhere.

> **To start a drag race (after you have selected the type of race and starting method), press <u>Select</u> from the main menu.**

For a few seconds, the GPX will "zero out" the internal accelerometers. Then either you can start when you're ready ("Standing start"), or start when the tree lights go green.

> NOTE: The internal accelerometers are extremely sensitive. Especially for drag racing, you must mount the GPX in such a way as to minimize vibration.

During the 0-30-0, 0-60-0, and 0-100-0 races, the display of the GPX will invert (i.e., reverse black and white) when you hit the top speed (30, 60, or 100 appropriately). This is the indication that you have hit the maximum speed and need to start the deceleration (braking) portion of the drag.
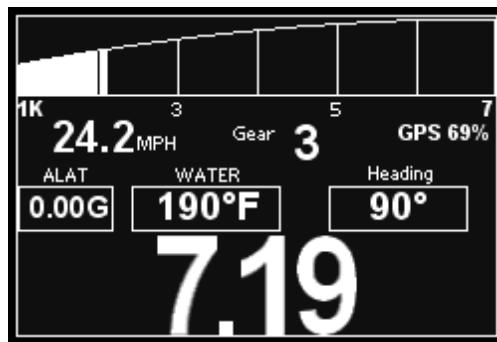
Similarly, during a roll-on, the display of the GPX will invert when you hit the minimum speed (e. g., 60 if the setting is for a 60-100 roll-on), and will revert back to normal when you hit the top speed.

When the drag is completed, its summary screen is shown:

To review your drag races, from the main screen press the **Left** and **Right** arrows to cycle through the races. Press **Menu** to return to the main screen.

When you start a drag session, if you change your mind, press any button to terminate it.

When you do a roll-on, if the roll-on maximum speed is less than the roll-on minimum speed + 10, the maximum speed is set to the minimum speed + 10. For example, if you set the roll-on minimum speed to 50, and the roll-on maximum speed to 55, the maximum will actually be set to 60. (There must be at least a 10 mph difference from the minimum to the maximum.)

1.3.2   More Details

Accelerometer sensitivity

Depending on the mounting of the GPX and the amount of vehicle vibration, you may need to adjust the acceleration sensitivity for drag races. The menu item **Acceleration sensitivity** allows you to change it. **High** sensitivity means the GPX will be most sensitive to the slightest movement; **Low** means the GPX will be more lenient to vibration.

```
┌─────────────────────────────────────┐
│ Acceleration sensitivity            │
│   Low                               │
│   Medium                            │
│  ▐Normal▌                           │
│   High                              │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
└─────────────────────────────────────┘
```
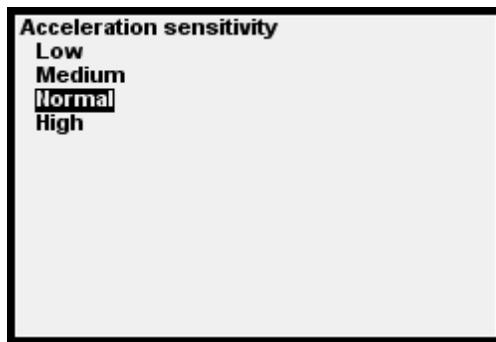
If you find that the GPX starts timing a drag race before you start your vehicle, change the sensitivity to a lower setting.

1.3.3   Menus

Type of drag race

        1/8 mile

        1/4 mile

        1 mile

        0-30

        0-60

        0-100

        0-30-0

        0-60-0

        0-100-0

        Roll-on - times race from a specified start speed (roll-on start speed) to a higher stop speed (roll-on stop speed)

Drag race starting method

        Standing start - start whenever you're ready

        Tree lights -- start when the LEDs go green (measures reaction time or foul) (not applicable for roll-on)

Roll-on start speed

Roll-on stop speed

Acceleration sensitivity - adjusts how sensitive start detection is

Low

Medium

Normal

High

Data acquisition setup and parameters

For detailed information, see the section **Data Acquisition (DAQ**)

Tachometer options – controls how the tach lights and tach bar during races will be utilized

Tach style – how the 8 LEDS will be utilized

Off – lights will not be used for anything

1 LED at a time – only one LED lights up at a time

All LEDs – more LEDs light up at increasing RPMs (consumes more battery power!)

Thumbs up/down – lights are not used for RPM. In Circuit racing, if you do a faster lap than the previous, the green lights will blink; if a slower lap, the red lights will blink.

Tach brightness – a setting from 1-10 of increasing brightness of the tach lights

Tach RPM Green – the minimum RPM that the green LEDs come on

Tach Yellow – the RPM at which the yellow LEDs start coming on

Tach Red – The RPM at which the red LEDS start coming on

Tach RPM white (shift light) – the "redline"

Shift light style - what happens when you exceed the "redline"

White LEDs blink

White LEDs solid

All LEDs blink

Tach Display Minimum RPM – this is the minimum RPM on the Tach that displays on the

LCD graph

Tach Display Maximum RPM – this is the maximum RPM on the Tach that displays on the LCD graph

LCD Display Options

    Backlight on/off control – control over the LCD panel backlight

        Off – no backlight

        On Activity – turns on for about 10 seconds after every keypress, and lap or split completed

        Always ON – always on (consumes more battery power!)

    Backlight brightness – a value from 1-10 controlling the brightness (higher values use more battery power!)

    LCD contrast – adjusts the contrast of the LCD panel

    Normal or reverse display

        Normal display – Black characters on a white background

        Reverse display – White characters on a black background

Power-Off Options

    Power off now -- selecting this immediately turns off the GPX

    Minutes until auto power off – after this many minutes of no activity, the GPX will turn off

File Maintenance

    Delete last viewed session (for deleting the last session you viewed in the GPX)

        (confirmation required)

    Delete a track and its sessions - see section on **File Maintenance**

        (confirmation required)

    Delete all sessions for a track -- see section on **File Maintenance**

        (confirmation required)

    Delete all session -- see section on **File Maintenance**

(confirmation required)

Delete all tracks and sessions -- see section on **File Maintenance**

(confirmation required)

File system check – checks the integrity of the GPX's built-in file system

Display Formats and Units

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11.2K – in K

Miles per hour or kilometers per hour

MPH – distances and speeds based on miles

KPH – distances and speeds based on kilometers

Fahrenheit or Celsius -- specify the temperature scale

Fahrenheit

Celsius

Latitude/longitude format - display and data entry method for coordinates

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Miscellaneous

Odometer/hour meters

        Show distance/time meters -- displays their current values

        Clear distance/time meter 1

        Clear distance/time meter 2

    Set local time – sets the local time as a variation from UTC (Greenwhich Mean Time)

    Personalization -- owner information

        Set personalization line 1

        Set personalization line 2

        Clear personalization line 1

        Clear personalization line 2

    Show Version Information – displays information about the GPX software version

    Reset settings to factory default – resets all settings. Does *not* delete sessions or tracks.

        (confirmation required)

Device mode and profiles

    Device mode - changes the basic racing mode of the GPX

        Circuit Racing – races that occur repetitively over the same course (circle, oval, road racing)

        Point-to-Point Racing – racing from a start point to a finish point (rally)

        Drag racing – 0-60, 0-60-0, ¼ mile, etc.

        Instrument Cluster – a "dashboard"

    Switch to another profile - switch to another vehicle's inputs/settings/calibrations

1.4   Instrument Cluster Mode

In Instrument Cluster Mode, there is only one screen -- the main screen. Use this mode as a "dashboard" when you are not racing. You can display speed, RPM, battery status, GPS status, as well as any of your data acquisition values.

Here is the default instrument cluster main screen:
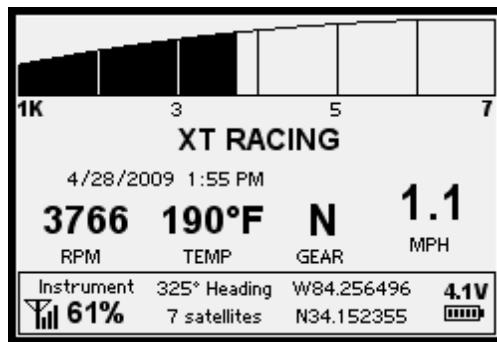
From this main screen, you can press **Menu** to enter the menu system.

1.5   **Menu System and Navigation**

The menu system allows you to change many settings within the GPX, as well as switch the basic racing modes. No matter what menu you're in, the operation is pretty much the same:

Left and **Right** arrows cycle through current menu choices – the current choice is always highlighted:
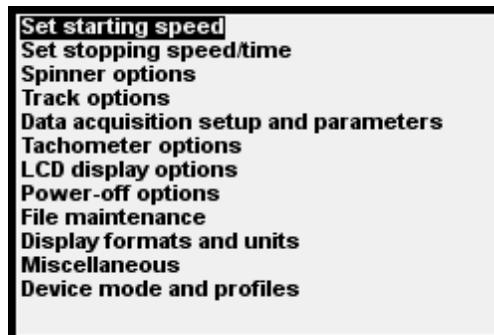
Select "selects" that option. It either records a menu setting, or goes to another menu.

When you are several levels deep in the menus, the previous selections show on the top of the screen, and the current choices are indented the furthest:
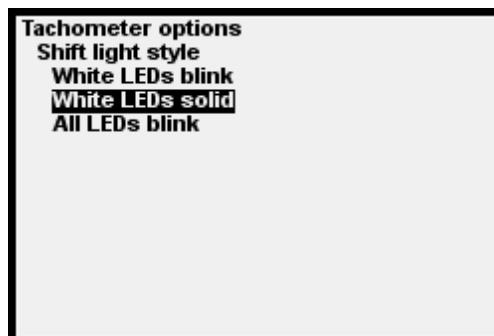
Menu "backs up". If you are at the top level of the menu system, it returns to the main

screen.

1.6 Switching Racing Modes

To switch racing modes (for example, you are in Circuit Racing and you want to go to Drag Racing), from the main screen, press **Menu** to go into the menu system. Use the arrows to highlight the last menu item (**Device mode and profiles**), and press **Select**. Press **Select** again on **Device mode**. Use the **Left** and **Right** arrows until the mode you wish to change to is highlighted, then press **Select**. The GPX will restart in the selected mode.

1.7 Data Acquisition (DAQ)

1.7.1 Basic Information

Your GPX is capable of capturing other data in addition to the speed, acceleration data, and GPS coordinates which determine the lap and split times. Y can capture RPM, gear, suspension, and other inputs from your racing vehicle.

> NOTE: throughout this manual, the words **input** and **channel** refer to one and the same thing.

Cabling and Electrical Information

There are two sets of expansion cables supplied with the GPX Pro, labeled "A" and "B". If you use these expansion cables, make sure that you plug the "A" cable into the "A" connector and the "B" cable into the "B" connector.

> NOTE: For *each* cable you connect to your vehicle, make sure that the black wire is well fastened to the vehicle's "ground" (essentially the negative terminal of the battery). If direct connection to the battery is not feasible, you may connect it to the metal chassis as long as a good electrical connection is made from the black wires to the chassis, and the chassis has a good electrical connection to the vehicle's negative battery terminal.

12V Power

You may connect the GPX to the 12V power (essentially, the positive terminal of the vehicle's

battery). This is done with the **RED WIRE OF CABLE "A"**. If you connect to the vehicle's 12V, then the GPX will always be powered by your vehicle. (The internal battery will be continuously charged.) So that the GPX does not drain the vehicle's battery when the vehicle is turned off, it is preferable to connect the 12V power wire to the GPX via a switched power point so that when the vehicle is turned off, the 12V is not supplied to the GPX. If this is not feasible, it is recommended that you disconnect **CABLE A** when you are done racing.

Analog vs. Digital Signals

Analog signals typically have a range of from 0 to 5 volts. These signals generally can have any value in that range. Typical examples of analog inputs would be engine coolant temperature, suspension via linear potentiometers, or throttle position. In addition, a switch input (on/off type of signal) (e.g., idiot oil warning light) may be connected to any of the analog inputs.

Digital signals are pulsed inputs (e.g., RPM or wheel speed sensor). The GPX can handle digital signals which have swings in the 0-5V range to signals with swings in the 0-12V range.

GPX DAQ Inputs

Analog/digital input # 1 is the **BROWN WIRE OF CABLE "A".** It may be used as *either* an analog or digital input.

Analog input # 2 is the **YELLOW WIRE OF CABLE "A"**. Analog *only*.

Analog input # 3 is the **BLUE WIRE OF CABLE "B"**. Analog *only*.

Analog input # 4 is the **GREEN WIRE OF CABLE "B"**. Analog *only*.

Digital input # 5 is the **GREEN WIRE OF CALBE "A"**. Digital *only*.

Wiring Summary – CABLE "A"

Black wire	Connect to vehicle's negative battery terminal
Red wire	Connect to (preferably switched) source of 12V (positive battery terminal)
Green wire	Digital input # 5 (default - digital RPM)
Blue wire	Connect to coiled wire around spark plug if utilizing coupled (inductive) RPM pickup
Brown wire	Analog/digital input # 1 (default - TPS)
Yellow wire	Analog input # 2 (default - temperature)

Wiring Summary – CABLE "B"

Black wire	Connect to vehicle's negative battery terminal
Red wire	3V output. May be used to power linear potentiometers for suspension inputs.
Green wire	Analog input # 4 (default - rear suspension)
Blue wire	Analog input # 3 (default - front suspension)
Brown wire	Do not use. Future expansion.
Yellow wire	Do not use. Future expansion.

1.7.1.1 Installing Cables

Two cables are supplied with the GPX Pro. Cable A and Cable B each have 6 wires.

1. Remove the 4 screws holding the back cover on the GPX Pro.
2. Flip the cover up as in the picture below. Be extremely careful when removing the back cover as the Li-Ion battery is attached to the back cover.
3. Plug in the A cable for onboard vehicle battery power and DAQ inputs 1, 2, and 5 (digital RPM). If you are using data channels 3 or 4, you will also need the B cable.
4. Route the cables as shown in the picture below. Cable B specifically has to route to miss the mounting post circled.
5. Looking from the back -- cable A goes in the far right grommet hole, and cable B in the middle one. The third grommet holes is used for the optional external antenna.
6. Make sure the grommets are oriented correctly, and near their final location
7. Flip the back cover over and fit the grommets to their holes.
8. Install the screws, being careful not to over-tighten them.e
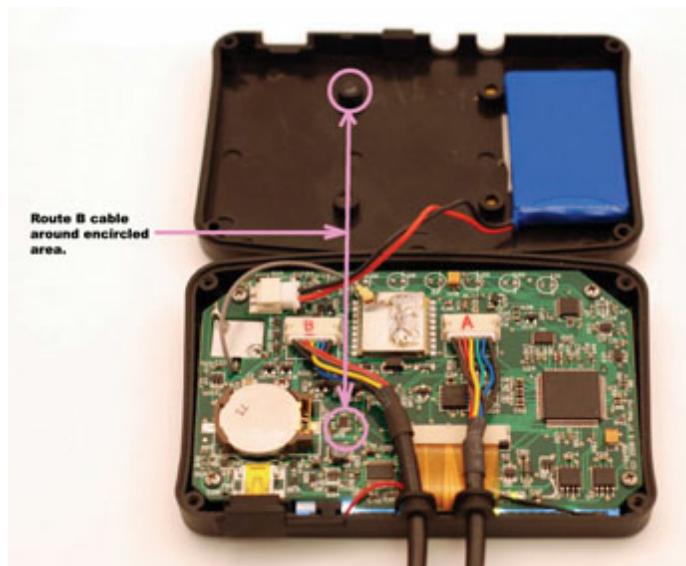
1.7.1.2 Wiring with Scotchlok Connectors

Included with your GPX Pro is a set of Scotchlok connectors that can be pressed onto your wires with no stripping or soldering required. Supplied initially are 6 of these connectors in order to begin wiring your vehicle to collect data. More Scotchloks and color-coded wiring can be purchased in our DAQ Wire Kits at www.xtracing.com. All wire used with Scotchlok connectors must be 22-16 AWG. We have found that most vehicles use wiring within this range. Make sure that the metal tab in each Scotchlok is pressed down firmly over both wires before you close the Scotchlok. There should be no bowing of the cap when you try to close it. If your cap appears bowed, then your Scotchlok is not fully engaged and your GPX may not record your data.

GOOD:

BAD:

1.7.2 Basic DAQ Setup

All DAQ setup is performed via the menu item **Data acquisition setup and parameters** from the main menu:

The first column is the channel number and name of that input. Note that the last 2 items (gear calculated and acceleration) are not connected to actual wire inputs -- they are "virtual" channels of data which you can capture. The item "Inductive RPM Pickup" corresponds to a wire wrapped around a spark plug on the **BLUE WIRE OF CABLE "A"**.

Each channel may independently be enabled (data will be captured) or disabled. Even if a channel is disabled for capture, it will still display current values on the various screens if it is properly calibrated. For example, you can still see RPM on your main screen even if it is not being captured.

Each channel has an individually configurable capture rate (see below). Depending on the type of input, from a minimum of 5 samples per second (**Hz**) to a maximum of 250 samples per second may be captured.

The **Left** and **Right** arrows move from item to item. When you are positioned at an item you wish to modify, press **Select**. (As usual, press **Menu** to exit out of this screen.)

When you press **Select**, either the item will be modified "in-place", or a menu of selections will be displayed. For example, when you change the **Hz** (capture rate), the "highlight" will change from reverse to a box:

When the box is outlined, you make changes as normal - **Left** and **Right** to cycle through the choices, **Select** to make that selection, **Menu** to exit.

When you press **Select** on a **Channel/Name** entry, you can change the type of that input. Select

from the list. Select **Custom** if you want to select one of the Generic types.

```
RPM
Throttle position
Water temperature (thermistor)
Gear position (analog)
Front wheel speed
Rear wheel speed
Front suspension
Rear suspension
Oil pressure (switch)
Oil temperature (thermistor)
Custom
```
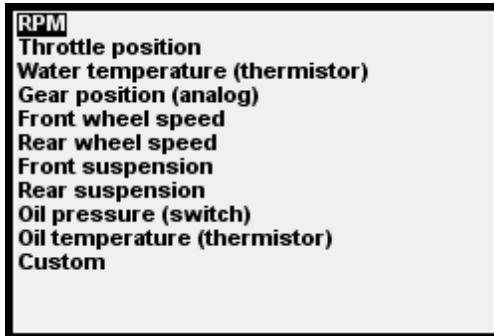
Pressing **Select** on an **Hz** entry allows you to change the sampling rate for that input.

> You should **not** record data at a higher sample rate than you need
> - higher sampling rates use up the memory more quickly in the
> GPX and result in less time that can be stored before data needs
> to be deleted.

Press **Select** on an **Enabled** entry allows you to change an input from enabled to disabled and vice versa.

When you press **Select** on a **Cal** entry, you may then calibrate or uncalibrate that input. Each type of data has a different calibration procedure.

Temperature- and switch-type inputs may have an alarm set. See the section below entitled **Alarms**.

The lower portion of the screen shows the current value for the currently highlighted input, and information about its calibration. Also, for analog channels, the approximate real-time voltage of that input is shown. This voltage reading can be useful when trying to determine if you have hooked up the input properly to the vehicle.

1.7.3 Typical Inputs

1.7.3.1 RPM

The GPX can record RPM data. RPM may be picked up in two different ways – either "direct" or "coupled" (induction).

"Direct" mode requires that a signal be available on your vehicle which is a pulsed, binary logic signal which is either generated by a Hall-effect-type pickup from a timing wheel, or is generated by the vehicle's engine control unit/module (ECU or ECM). Most fuel-injected engines will have such a signal available.   The signal can be as low as a 3.3-volt peak-to-peak signal, or as high as a

12-V peak-to-peak signal. You might also use a one of the fuel-injector outputs of the ECU as the RPM input.

> NOTE: Direct connection is the most accurate and reliable method of determining RPM.

To utilize "direct" mode, connect the **GREEN WIRE OF CABLE "A"** (digital input # 5) or the **BROWN WIRE OF CABLE "A"** (analog/digital input # 1) to the to the vehicle's digital tach signal.

If your vehicle has no such signal, you can use the "coupled" method. This is accomplished by wrapping an insulated wire (preferable 22-24 gauge wire) around a spark plug wire about 4-7 times and connecting that to the appropriate input on the GPX. You can check if the coupled pick-up is working correctly by looking at the RPM indication on the main screen. If it is not picking up properly, you can try a few more wraps of the wire around the spark plug wire until the RPM gets picked up reliably.

Once the pickup is working correctly, apply a few wraps of electrical tape over the coiled wire to hold it in place.

To utilize "coupled" (inductive) pickup mode, connect the **BLUE WIRE OF CABLE "A"** to the wrapped wire around the spark plug wire.

Both types of RPM, direct or coupled, may need to have the reported rpm either multiplied or divided by 2, 3, or 4. For example, the engine might be running at 1000 rpm, but only 500 rpm are showing on the screen. In this case the input would need to be multiplied by 2. Whether or not this is required depends on the number of cylinders, 2- or 4-cycle engine, and type of signal you are monitoring.

To set the multiplier or divider, go to the **cal** column of the RPM input and press **Select**:

Then, use the arrows to make your choice, and press **Select**:

In addition, a coupled input may need to have an internal threshold value changed. This threshold value is used by the GPX's internal circuitry for determining a valid signal. For coupled RPM capture, you may need to adjust both the threshold, and the number of wraps around the spark plug wire, to obtain a reliable RPM reading.

If you have more than one RPM input connected (for example, an RPM input on one of the digital inputs, and a inductively coupled [wire-wrap] connection), the GPX will report the the RPM from the digital input as the correct RPM. In other words, the digital input has precedence over the coupled input.

1.7.3.2   Throttle Position

Throttle position needs two points for calibration -- the 0% throttle position (no throttle applied) and the 100% throttle position (throttle completely applied). On most vehicles, you should do this calibration while the vehicle is turned on, but not running (it might not be a good idea to run full throttle in neutral!).

1.7.3.3   Temperature

Most vehicle temperature sensor are thermistors (resistors which vary resistance depending on their temperature). These sensors need to be calibrated within the GPX at several different temperatures in order for them to display an accurate temperature reading.

The GPX allows you to enter up to 10 different calibration points for each temperature input. If you make a mistake, you can either delete all calibration points, or you can delete one of the

points you've calibrated and do it again.

For best results, you need a small, inexpensive, non-contact infrared temperature "gun". You can purchase one from www.xtracing.com.

You need to point the gun at a place where the coolant is circulating:

For each temperature you want to calibrate, do the following:

On the Data Acquisition screen, highlight the **Cal** column of the temperature input, and press **Select**:

Select Calibrate:

```
Calibrate
Uncalibrate one temperature
Clear calibration
```

Using the arrows, select the temperature; when the "gun" reads that temperature, press **Select**:

```
Choose a temperature using the arrows.
When the input is at that temperature,
press Select.  (Press Menu to cancel.)
    The following temperature(s) have
    been calibrated: 139, 116, 100, 91, 64

Fahrenheit temperature:  [72]



      Approximate voltage 0.4V
```

Repeat this up to 10 times. You should try to get a pretty nice distribution of temperatures from the expected lowest to expected highest temperature.

Temperature channels can have alarms associated with them. See the section on Alarms.

1.7.3.4 Gear

Gear

Vehicles that have a gear sensor (e.g., many fuel-injected motorcycles) have a gear sensor which can be used to determine gear. This type of sensor provides an analog voltage output which is different for each gear. To calibrate this input, you must first enter, in the menu system, the number of gears the vehicle has (not including neutral). Then you are prompted to put the vehicle in each gear, and neutral. This completes the calibration. The data acquisition system will then record this input as N (neutral), or 1-6 (for example, for a 6-gear bike).

There is an alternate method of capturing and calibrating gear data if a gear sensor is not present. You must be connected and picking up RPM data (although you do not need to capture it if you don't want) in order for this method to work. For this calibration, you need to drive/ride the vehicle in each gear, and when you are going smoothly and straight ahead in each gear, press the Select button. (This records the relationship between speed and engine RPM to determine a final drive ratio.) It is important that the tires are not slipping.

> *Be especially careful when doing this calibration – since it requires you to read the prompts and press the Select button at the appropriate time, while you are operating the vehicle, you need to be extremely careful during this procedure and pay close attention to the track and other traffic that you might encounter.*

There are several limitations to note with this method:

1) if you have tire slippage, an incorrect gear might be computed (due to the engine running at a higher rpm than normal in that gear for the speed you are travelling)

2) there is no recording of a neutral (neutral cannot be determined with this method)

3) a change in tire pressure or diameter, or a change in the gear ratio (e.g., motorcycle front/rear sprockets), will generally require that this method be recalibrated

You have the option, via the calibration menu, of calibrating one gear at a time, or all gears at once in succession.

To calibrate, highlight the **cal** column for **Gear from RPM/speed** and press **Select**:

Channel/Name	Hz	Enabled	Cal.	Alaram
1/TPS	100	On	Cal	Off
2/WATER	5	On	Cal	Off
3/SUSPF	250	Off	Uncal	Off
4/SUSPR	250	Off	Uncal	Off
5/RPM	100	On	Cal	Off
Inductive RPM pickup	5	Off	Cal	Off
Gear from RPM/speed	5	On	**Cal**	Off
Acceleration	5	Off	Uncal	Off

Data type: Gear from RPM/speed
# of gears: 6
Gears calibrated: 1 2 3 4 5 6

First, set the number of gears. Then, pick a gear to calibrate, get your vehicle going in that gear, and press **Select**:

Go into gear # 1, then press Select
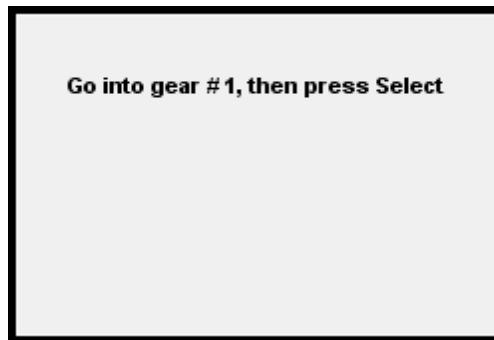
When you're done, a check-mark will be displayed next to each gear that is calibrated:

```
Calibrate one gear
√Calibrate gear 1
√Calibrate gear 2
√Calibrate gear 3
√Calibrate gear 4
√Calibrate gear 5
√Calibrate gear 6
```

NOTE: When you are going below about 3mph (5kph), the gear will be reported as "N" when utilizing rpm/speed ratio to report gear.

There is one particular advantage to using the rpm/speed ratio for capturing gears (even if you have a gear sensor), if you are already capturing RPM: using this method does not "use up" an analog input.

Using different gear ratios (cars) or sprocket ratios (motorcycles)

If you sometimes (or often!) change your transmission ratios, the GPX can automatically account for that change and still report correct gear changes.

We'll use a car as an example first. Let's assume you have calibrated the gears, and you car's gear ratio is 3.00. Go to the menu **Set/change axle ratio**, **Set axle ratio at initial calibration**, and enter 3.00. You may then use the GPX and as long as you do not change your axle ratio, the gear data will be properly recorded. Now let's assume you make a modification to your vehicle, and the new ratio is 3.63. ***You do not need to go through the length gear calibration process***. Merely go to the menu item **Set/change axle ratio**, **Enter current axle ratio**, and enter 3.63. You're good to go.

```
Set number of gears
Calibrate one gear
Calibrate all gears
Set/change axle ratio
Set/change sprocket ratio
```
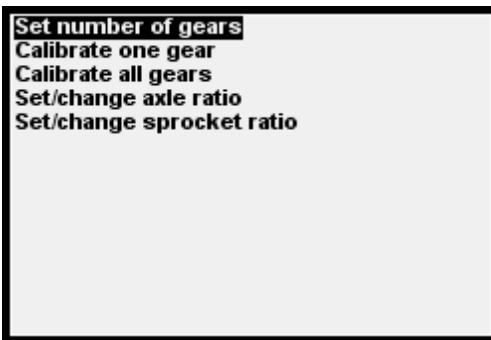
For a motorcycle, the process is identical, except you enter front and rear sprockets instead of axle ratios. For example, you might enter 16-43 (front sprocket 16 teeth, rear sprocket 43 teeth) as your initial axle ratio (assuming you calibrated all your gears with that 16-43 combination); then, when you change your sprockets, merely enter the current sprocket ratio (e.g, 15-44).

1.7.3.5   Acceleration

Your GPX is equipped with a sensitive 3-axis accelerometer. This, combined with GPS data, allows data acquisition of G forces involved with acceleration/braking ("longitudinal" acceleration/ deceleration), and turning ("lateral" Gs). It is also used for accurate determination of the start of some types of Point-to-point and Drag races.

In GPStudio, longitudinal Gs are as follows: >= 0G (positive numbers) = acceleration; < 0G (negative numbers) = deceleration. For lateral Gs, negative numbers = turning to the left; positive number = turning to the right.

Since the GPX may be mounted in any orientation, the accelerometers require calibration. Calibration requires that the GPX be mounted securely on the vehicle, and then the vehicle be started and stopped in as straight a line as possible (i.e., accelerated from a complete stop to a speed, and then decelerated back to 0). The more you accelerate and decelerate during the calibration, the better, but keeping as straight a line as possible is even more important. The calibration will only be as accurate as this "trial run".

> You must reach a top speed of at least 7 mph for the calibration to be successful.

> NOTE: any re-positioning of the GPX on the vehicle (even in a slightly different orientation) requires accelerometer re-calibration.

Since the accelerometers are highly sensitive, it is important that for accurate readings, the GPX be mounted FIRMLY on a SOLID part of the vehicle.

> Do not mount the GPX to a surface that is subject to excessive vibration or movement.

1.7.3.6   Wheel Speed

The GPX can acquire wheel speed data on either channel 1 (digital/analog) or channel 5 (digital only).

In order to acquire wheel speed, the wheel needs to have a hall-effect (magnetic) or similar pickup which determines the rotational speed of the wheel. (Another example might be an infrared or laser source which gets "interrupted" by a disc with holes that is mounted to the wheel.)

(A simple example is the bicycle computer. It consists of a magnet attached to a spoke of the

wheel, and a "pickup" which detects the magnet passing by.)

To increase accuracy, the more "pickup spots" you can utilize on the wheel, the better. The pickup spots should be as evenly spaced around the wheel as possible.

The pickup must output a digital signal of at least 0-5V amplitude, up to 0-12V amplitude.

The GPX supports from 1 to 99 pickup points per wheel speed input.

In addition, you must enter the circumference of the tire, in millimeters. The more accurate you can determine that circumference, the more accurate the results will be.

1.7.3.7   Suspension

The GPX can acquire suspension data on any of the analog channels.

Suspension is usually determined from a **linear potentiometer**, which basically is a sliding resistor.

A typical linear potentiometer has 3 wires -- positive voltage, ground, and the output signal. Depending on the extension of the slider, the output signal's voltage will vary continuously between the positive voltage and ground.

For the GPX, the positive voltage should be connected to a voltage between +3V and +5V. A convenient source of +3V is the **RED WIRE OF CABLE "B"**.

Basic calibration of the potentiometer involves measuring the voltage when it is fully compressed, measuring the voltage when it is fully extended, and specifying how many millimeters of travel the slider moved from the fully compressed to the fully expanded position.

You may perform this calibration either before it is mounted to the vehicle, or after it has been mounted.

If you calibrate it *before* it is mounted, you will be measuring the full travel of the device. That is OK, but it does not tell you what the limits of travel are when it is mounted *on* the vehicle. It may not be possible to fully extend and compress the potentiometer when it is vehicle-mounted.

Make sure you choose a potentiometer that has *more travel* than can occur when it is mounted. Otherwise, the vehicle may compress or extend it beyond its physical limits and will probably destroy it.

There is an optional calibration setting, called <u>sag</u>, which you may calibrate if you wish. This calibration point represents the "at rest" (neutral) position of the slider. This is always done after it is mounted on the vehicle, and should be calibrated with the rider/driver in position in the vehicle. When the sag is calibrated, GPStudio can indicate when the suspension travel is compressed or expanded, and how much, relative to this neutral position.

1.7.3.8 Switch Input

A switch input may be connected to any of the analog channels. It is an input which only can be "on" or "off".

You can specify what text you want displayed:


```
Select switch descriptive text
Off / On
0 / 1
Open / Closed
Low / High
```
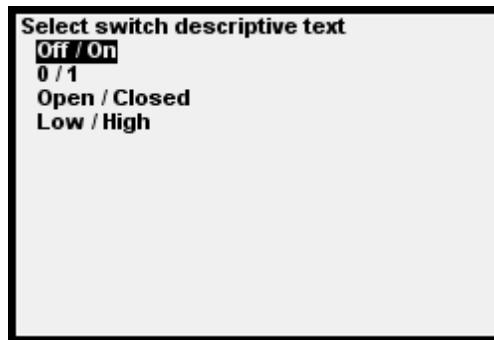
In addition, you can specify the *polarity* of the text:
    <u>Normal</u> polarity means the first text item is displayed for a *low* voltage, and the second item for a *high* voltage.
    <u>Reverse</u> polarity means the first text item is displayed for a *high* voltage, and the second item for a *low* voltage.

To calibrate a switch input, you are prompted first to go to the "off" position, then the "on" position. At each position, press <u>Select</u> to calibrate to that voltage. A switch that is properly connected to the GPX should show a significantly different voltage in the "off" and "on" positions.

A switch input can have an alarm associated with it. See the section on Alarms.

1.7.4 Generic Types of Inputs

If you select Custom as the type of DAQ input, you have a choice from the following menu:

```
Custom
0-100%
Zero-based
Temperature
Raw
Switch
```
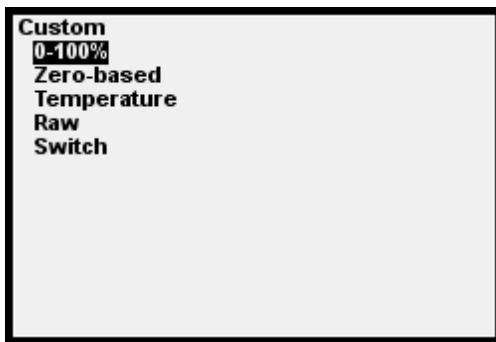
1.7.4.1 0-100%

A 0-100% input is an input which gets calibrated at 0% (its minimum value) and 100% (its maximum value). This is similar to throttle position. See that section for more information.

1.7.4.2 Zero-based

A zero-based input is a generic input which has a base value (0 point). Only that point gets calibrated.

The value displayed and used in GPStudio will be an arbitrary number above or below this 0-point, depending on whether the voltage is higher or lower than the calibration point.

1.7.4.3 Temperature

This is for calibrating a thermistor input, with up to 10 calibration points. See the section on Temperature under **Typical Inputs** for more information.

1.7.4.4 Raw

A Raw input has no calibration at all. It merely reports a number from 0 to 1023, where 0 represents 0 volts, and 1023 represents about 5.0 volts.

1.7.4.5 Switch

A switch input can have only one of two values (essentially, *on* or *off*). See the section on Switch Input under **Typical Inputs**.

1.7.4.6 Linear Analog

A "linear analog" type of input can be used for some types of analog inputs that are not explicitly supported by the GPX.

The most important requirement of a linear analog input is that the correspondence between the output voltage and the input's "value" must be linear.

As an example -- let us assume that you are connecting a brake pressure sensor. A typical such sensor outputs a voltage of 0.5V at 0psi, and 3.7V at 2000psi.

So, you may use a linear analog input for this device. You are prompted for two calibration points -- at point one, you input the voltage (0.5V) and output value (0), and at point two, you do the same (voltage 3.7, output value 2000). That's all there is to it. You may now acquire data on this channel and the "readout" will be the pressure in psi.

1.7.5   Alarms

Temperature and switch inputs may have alarm(s) associated with them.

For a temperature channel, you may have one or two alarms set: one alarm may be set for the temperature *exceeding* a specified temperature, and another may be set for the temperature *falling below* another specified temperature.

For a switch input, you can specify that the alarm occurs either when the switch is at a low voltage (below the calibration voltage) or a high voltage (above the calibration voltage).

Alarm conditions will cause notification on either the main screen of any of the modes, or during the running ("spinner") screen for Circuit and Point-to-point modes. (An alarm will not occur during a drag race since the race lasts such a short period of time.)

When an alarm condition occurs, the screen will flash with the channel name and the value:

The screen will flash between its normal display and this alarm condition as long as the alarm condition occurs.

1.7.6   General DAQ Notes

When you change the type of an analog channel, all parameters will default to a default state, and the name will be changed to "INPUT 1", for example.

When you change the type of analog channel, it will automatically be "de-calibrated" (i.e., there will be no calibration set for that channel). When a channel is not calibrated, that channel will not be captured, even if it is enabled. The channel must be calibrated in order for data acquisition to occur for that channel. (There is one exception to this rule: if a channel is defined as type "raw", it cannot be calibrated, but even so, it is captured if enabled.)

When you change the descriptive name of an analog channel, if the name has been defaulted to (e.g.) "INPUT 1", then on the first key press the name will be cleared to allow entry of the new name.

You may "de-calibrate" (i.e., remove calibration information for) an analog channel. The primary use for this would probably be for a temperature-capture channel, where many calibration points are set. So, for example, if a mistake is made in the calibration for a temperature channel, since an individual temperature-point cannot be deleted, you must delete all calibration information for that channel, then re-calibrate.

Don't worry if you mess up a calibration – you can re-do a calibration at any time.

If a channel is not calibrated, its value will display as "-".

1.8   Time and Distance Meters

The GPX has two internal time and distance meters. These each keep track of the active time and distance the vehicle traveled, whenever the GPX is receiving a valid GPS signal.

The two meters are independent of each other, and either may be cleared at any time.

```
Miscellaneous
  Odometer/hour meters
  Show distance/time meters
  Clear distance/time meter 1
  Clear distance/time meter 2
```

```
Meter # 1
  Time: 2 hours 52 minutes
  Distance: 87.06 miles
Meter # 2
  Time: 2 hours 52 minutes
  Distance: 87.06 miles
```
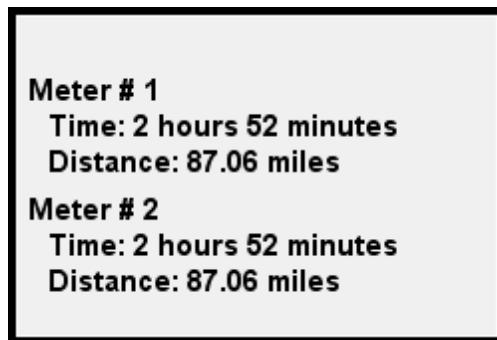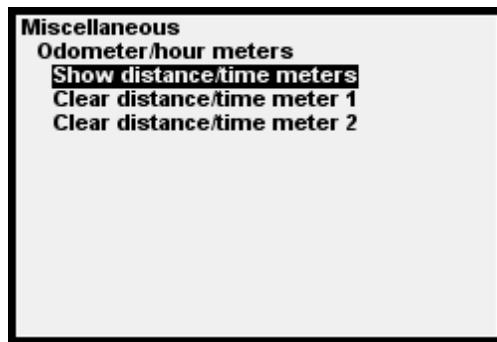
1.9   Miscellaneous Information

1.9.1 Tach LCD display and LED/Shift lights

Tach LCD display

If you are connected to an RPM input, you have several different ways of displaying the current RPM.

On any main screen or running ("spinner") screen, you may display the RPM as text (e.g., 11200 or 11.2K). You can of course customize the size and position of this text via GPStudio.

Also, on any main or running screen, you may display the RPM as a graphical "tach bar" on the LCD. Again, you can control the position and size of this tach bar with GPStudio.

In addition, for the tach bar, you can select the minimum and maximum RPM that will show. For example, when racing, you may only be interested in the range of 8000 to 14000 RPM. In the menus under **Tachometer options**, you will see the two menu items that allow these values to be modified:
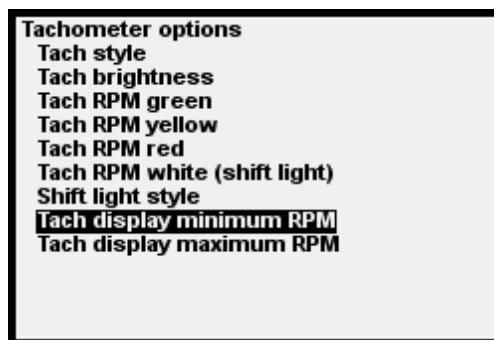
When you make a change to the minimum or maximum, you will see a sample display:
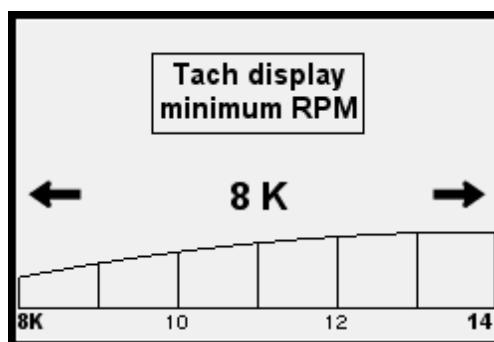
Tach LED lights

You can also display tach information on the LEDs at the top of the GPX. The RPMs that "trigger" these lights can be different from what is displayed on the tach bar graph.

The menu item **Tach RPM green** is the RPM at which the green LEDs turn on. Below this RPM, no

LED lights will display.

Similarly, the menu item **Tach RPM yellow** is the RPM at which the yellow LEDs turn on, and **Tach RPM red** is the RPM at which the red LEDs turn on. You should set green at a lower RPM than yellow, and yellow at a lower RPM than red.

The last two LEDs are white, and you specify the RPM at which the white LEDs come on ("shift indication"). The RPM at which white comes on should be greater than red.

Shift LEDs

You have three choices when you hit the specified RPM for **Tach RPM white (shift light)**. You can choose to either have the two white LEDs blink or come on solid, or have all 8 LEDs flash, via a menu item:

Tachometer options
Shift light style
White LEDs blink
White LEDs solid
All LEDs blink
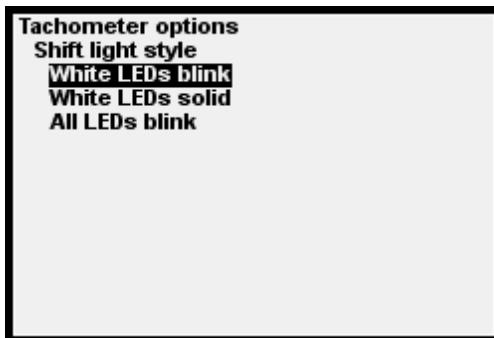
1.9.2   Session Number IDs

Each race in the GPX is assigned a Session ID. This is just a number that the GPX assigns to each race.

1.9.3   Normal / Reverse LCD Display

You might find that in darker conditions, (e.g., night racing), that the combination of Reverse LCD display (white display on a dark background), along with the backlight, might be a useful configuration.
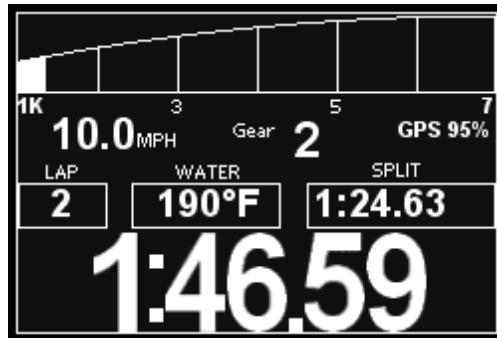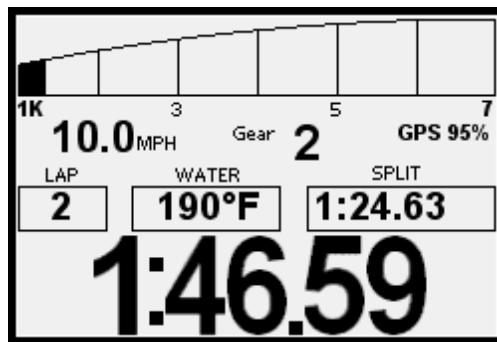
1.9.4   Backlight

When enabled, the LCD backlight brightness can be selected from 1 (dim) to 10 (bright). Since it uses a considerable amount of power, do not use more backlighting than necessary when running off the internal battery. Backlighting reduces the length of time the battery will hold its charge.

Select the backlight options from the **LCD display options** menu:
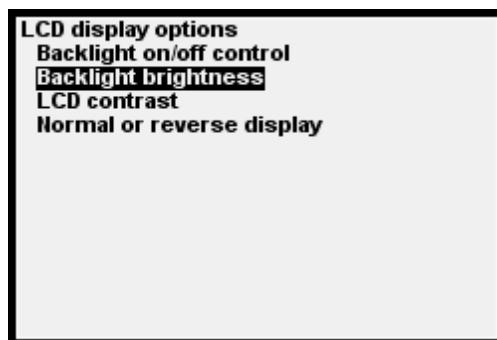
1.9.5   Mounting

The 8 tach leds are quite bright but highly directional. If you will be using the tach lights, you will get best visibility when the GPX is mounted so that you view it head-on, as opposed to mounting at an angle to your view.

If you will be racing at night, you may find that the tach lights are too bright, even at the lowest brightness setting. In this case, it is recommend that the GPX either be mounted at an angle to your line of view to reduce the apparent brightness, or turn off the tach lights altogether.

There are 4 threaded brass inserts on the back of the GPX. These screws are metric M3 threaded. If you mount the GPX using these brass inserts, **make sure that the length of M3 screw that you are using is not so long that it could potentially "break through" into the inside of the GPX case**.

For many motorcycles, a custom anodized billet aluminum mounting bracket is available from XT Racing at www.xtracing.com.

1.9.6   Time and Time Zones

GPS reports its time as UTC time (which is essentially Greenwich Mean time). Your local time will probably vary from UTC time by a number of hours. For example, during non-Daylight-Saving time in the U.S., the eastern time zone is UTC time – 5 hours. (There are some places where the difference may be in 30- or even 15-minute increments – for example, Nepal is UTC + 5:45.)

The GPX has a menu item which allows setting the local time. It uses the UTC time as reported by the GPS as the basis, and, using the arrows, you can increase the time of day (press **Right**) (UTC +) or decrease the time of day (press **Left**) (UTC -) in 15-minute increments until the time shown is correct for your local time. Then press **Select** to finalize your selection. This time will then be stored with your laps, and this "difference from UTC" will remain as a setting in the GPX until you change it.
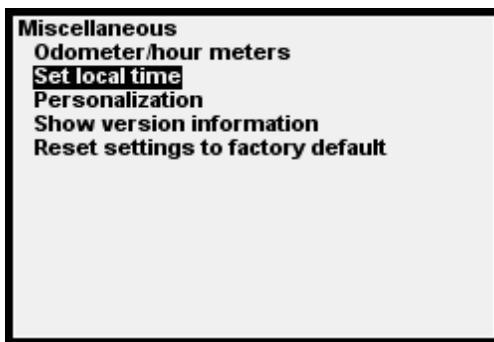
The default main screen displays the current date and time. However, until the GPS acquires a

good signal from the satellites, "Date/time N/A" (not available). As soon as a good signal is acquired, the display will update to the current date and time.

1.9.7   Battery and Charging

The internal Li-Ion battery, when fully charged, will usually power the device for about 4-5 hours. (This time may be shorter due to excessive use of the backlight or the tach lights.)

The battery is charged whenever the device is connected to a 12V source through the external cable, or whenever it is connected via the USB port.

A full charge takes about 8 hours.

When connected to USB, the GPX will not automatically power down.

You may use any USB charging device (e.g., cigarette lighter, plug-in wall transformer) to charge the GPX that is capable of supplying 400 milliamps (ma) of current.

On the default main screen, you will see a battery status indicator. When the GPX is powered by battery alone, the display will show an approximation of battery charge left (100% = fully charged, 0% = completely discharged).

When the GPX is powered by either a USB connection or a 12V vehicle connection, the display will show the approximate charging voltage to the battery. The GPX is generally pretty close to fully charged when that voltage is around 4.0V.

1.9.8   Powering Down

The device does not power down if connected via USB only (i.e., no 12V present). Therefore, the internal battery will be continually charged while plugged into USB.

1.9.9   Memory

Each captured session uses several "directory entries". If there are not enough available directory entries to store another session, a message will be displayed each time you go to the main screen.

Also, the main screen shows information on the amount of memory available -- % free, and minutes free. The percent free is the actual percentage of memory that is available and not in use. The "minutes free" is the approximate number of minutes of racing time that the timer will store based on the current data acquisition sampling rates.

1.9.10   File Maintenance

The GPX stores all of its session data, and other information like tracks and settings, in "files" in its internal flash memory storage. (The GPX contains approximately 8 megabytes of flash

storage.)

There are a limited number of "files" that may be stored in the GPX. For Circuit or Point-to-point mode, approximately 100 races may be stored before the GPX memory approaches being full. For Drag mode, approximately 130 races may be stored.

The number of bytes used up by each race depend upon the length of the race, and the amount of data acquisition data stored. The higher the sample rates for data acquisition channels, the more memory is consumed each second, and therefore the less total time may be stored in the GPX.

The default main screen shows the approximate number of minutes of racing time that can be stored, based on the currently selected data acquisition settings, before the GPX memory becomes full. It also shows the approximate percentage of free space in the GPX -- as that number decreases toward 0, the GPS is becoming full.

When either the total amount of memory becomes close to getting full, or the number of races nears the limit of storage, a message will pop up indicating that you should delete races (sessions) before continuing. You will probably want to download those races to GPStudio before deleting the races in the GPX -- if you delete them in the GPX and have not downloaded them to GPStudio, those races cannot be recovered and are gone forever.

Delete options in Circuit and Point-to-point mode

Delete last viewed session - deletes the last session that you viewed when scrolling through sessions. Only that one session is deleted.

Delete a track and its sessions - for this option you select a track, and that track and all sessions (races) run at that track are also deleted. If you go back to that track, it will not recognize it as an existing track, since you deleted it.

Delete all sessions for a track - this deletes all races at a track, but does not delete the track information (start/finish/splits).

Delete all sessions -- deletes all races in the GPX. All tracks remain.

Delete all tracks and sessions -- deletes all races and tracks.

> NOTE: for all of the above delete operations, only those sessions and/or tracks are deleted in the corresponding mode. For example, in Circuit mode, only circuit mode races and/or tracks are deleted; in Point-to-point mode, only point-to-point races and/or tracks are deleted.

Delete options in Drag mode

Delete last viewed session - deletes the last session that you viewed when scrolling through

sessions. Only that one session is deleted.

Delete all sessions - deletes all Drag mode races.

1.9.11 Other Notes

The maximum lap or race time displayed is 9 hours, 59 minutes, 59 seconds. The display will "freeze" at that point if the lap time exceeds that time.

In circuit mode, if you have the GPX turned on in your car, for example, when just driving somewhere, once you hit the "starting speed", it will think you are racing and begin looking for a track or loop. The GPX will actually start storing data, but that data will be automatically deleted when you go less than "stopping speed", or if you travel more than 15 miles.

1.10 Introduction to GPS

The Global Positioning System consists of a constellation of satellites orbiting the earth. There are currently 24+ such satellites in orbit. It is commonly thought that the satellites are stationary in the sky ("geostationary") like DirecTV or DishNetwork satellites, but this is not the case. The satellites are constantly in motion – if they were not, there could be places on earth (imagine a "canyon" in New York City) where reception could be essentially permanently blocked. Since they are moving, any "outage" would only last for a little while.

If you are in a big open field, up to 12 satellites should be "in view" at any time. Depending on cloud cover, atmospheric conditions, etc., less than 12 satellites may be "in view". On the main screen of the GPX, the number of satellites in view, and the relative "quality of signal" is displayed. You may find that positioning the GPX in a different spot on your vehicle may have an effect on signal quality. Generally, the more "open" the GPX is to the sky, the better the reception.

Also, as a result of the constant motion of the GPS satellites, you may find that, at the same track, on different days, or even within the same day, you may find significant differences in the quality of signal.

The GPX uses a sensitive internal antenna (mounted inside the GPX enclosure) as standard. If you wish to improve your GPS signal quality pick-up, you may order an auxillary external antenna with magnetic mount which can be positioned up to 10 feet from the GPX unit, for improved reception (for example, it may be mounted on the roof of a racing car, or on the tail section of a motorcycle).

The GPX requires a minimum quality of GPS signal before it can be used. It must have at least 4 satellites in view, and the EHPE (estimated horizontal position error) must be less than 5.00.

If you are interested in more detailed information about how GPS works, visit the following links:

http://sss-mag.com/gps1.html

http://en.wikipedia.org/wiki/Global_Positioning_System

1.11 Troubleshooting

- If the GPX appears be not responding, you can press all 4 buttons simultaneously to reset the device.

> Only perform the 4-button reset if the GPX is not responding. If the GPX is in the middle of a file operation, there is a possibility that the file system could become corrupt.

- You may need to adjust the LCD contrast for optimal display under conditions of very high and very low ambient temperatures

- If you get a warning about "file system full" or "low on directory space", you need to clear out some sessions in your GPX before continuing. If you want to save those sessions before deleting them, connect up to GPStudio and download those sessions to your PC. After that, using the **File Maintenance** menu option, select one of the delete options and delete some or all sessions to free up some space.

- When you connect the GPX to your PC, it may take up to 10 seconds before you hear the "da-ding" sound indicating that the GPX is properly connected. This is normal.

- Occasionally when you connect the GPX to the PC, you may not get a "da-ding" sound, or you might not get the normal "PC connected" message. In that case, disconnect the GPX, wait a few seconds, and try again.

- If an asterisk ("*") appears instead of a data value on one of the screens, that indicates that the field is not wide enough to display the value. Go into GPStudio and make the field wider.

1.12 Profiles (multiple vehicles)

You can easily use the GPX for up to 4 different vehicles and keep the settings for each vehicle (inputs connected, calibration settings, DAQ recording rates) separate and distinct. You do this by using profiles.

The profiles are identified by the first line of personalization. So, let's say you have a brand new GPX and you want to use it for two bikes. Out of the box, change the personalization line 1 to, for example, BOB GSXR1000. (The out-of-the-box personalization line 1 is "PROFILE 1".)

Connect inputs, calibrate, etc.

Now, to set it up for a second bike: go to **Device mode and profiles**, and select **Change to another profile**. Select PROFILE 2. The GPX will reboot, and now it will "be in" PROFILE 2. Change personalization line 1 to, for example, BOB GSXR600. Connect it to your other bike, and hook up inputs, calibrate, etc.

You have now set up two profiles for two bikes. Whenever you switch the GPX from one bike to the other, just go to the menu and change to the appropriate profile.

Please note that the "tracks file" (list of track names, start/finish lines, split points) is common to all profiles. Also, when you browse through your session data, you will see all sessions, no matter what profile it was recorded under.

2   XTStudio

A perfect companion to the myriad functions in the GPX, XTStudio allows you to take the data gathered on track and analyze it in detail on your Windows enabled PC. Review your sessions in real time with your data streaming in graphs or on gauges to help isolate any trouble areas you may have on the track.

Watch as you let off the throttle and your RPMs fall heading into a turn and compare your turn entry with your other entries into that same turn. Watch data gathered on corner exit to see where you were on the throttle early and where you were late, allowing you to find the lap where you performed the best.

Customize everything from the appearance of your main screen to the data displayed while you are out on track using XTStudio's integrated GPX display customization features.

With XTStudio, your laps come to life.

2.1   Loading sessions

Before you can use XTStudio to compare your races you will need to connect your device to the XTStudio database and download your sessions. Every time you connect your device while XTStudio is running the sessions currently on the device will be compared to the sessions already present in the database. If there are any un-downloaded sessions on the device, XTStudio will load the **Session Downloader** and prompt you to download your sessions. But before you can download any sessions, device must be "linked" to your XTStudio database.

2.1.1   Connecting a device

When you connect your device to XTStudio with the USB cable, after you hear the da-ding connection sound, XTStudio will communicate with the device for a second. After this, the status bar in the lower right corner will switch to **Connected**.
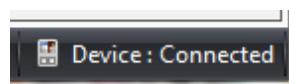
If this is the first time that the device has been connected to XTStudio then the **Device Connection Setup** dialog will appear. The device connection dialog will have two options. The first option is used if this is the first device you have ever connected to XTStudio or if you want to manage multiple physical devices (not multiple profiles on one device) with one instance of XTStudio. In most cases, simply click **Connect to a new device** to setup your device with the database.
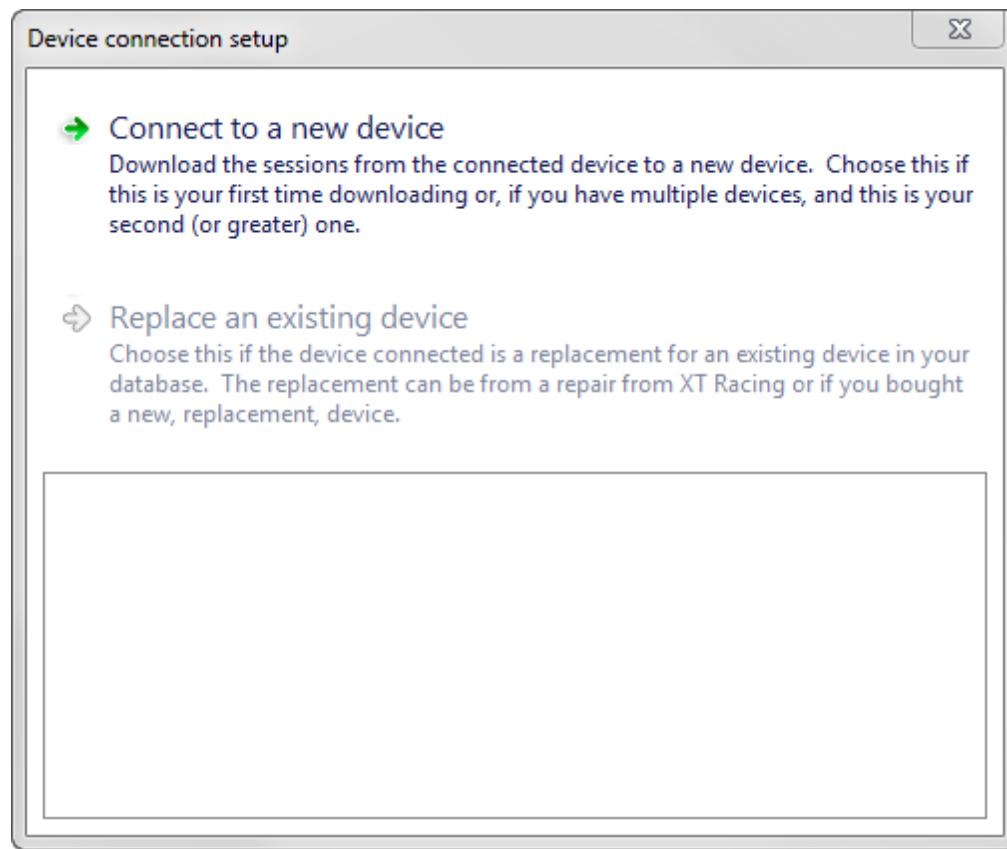
The other option is only used if the device you are connecting is a replacement (due to buying a new one or sometimes from and authorized repair with XT Racing). In this case, you will choose the existing database entry that this device is replacing, then click **Replace an existing device**.
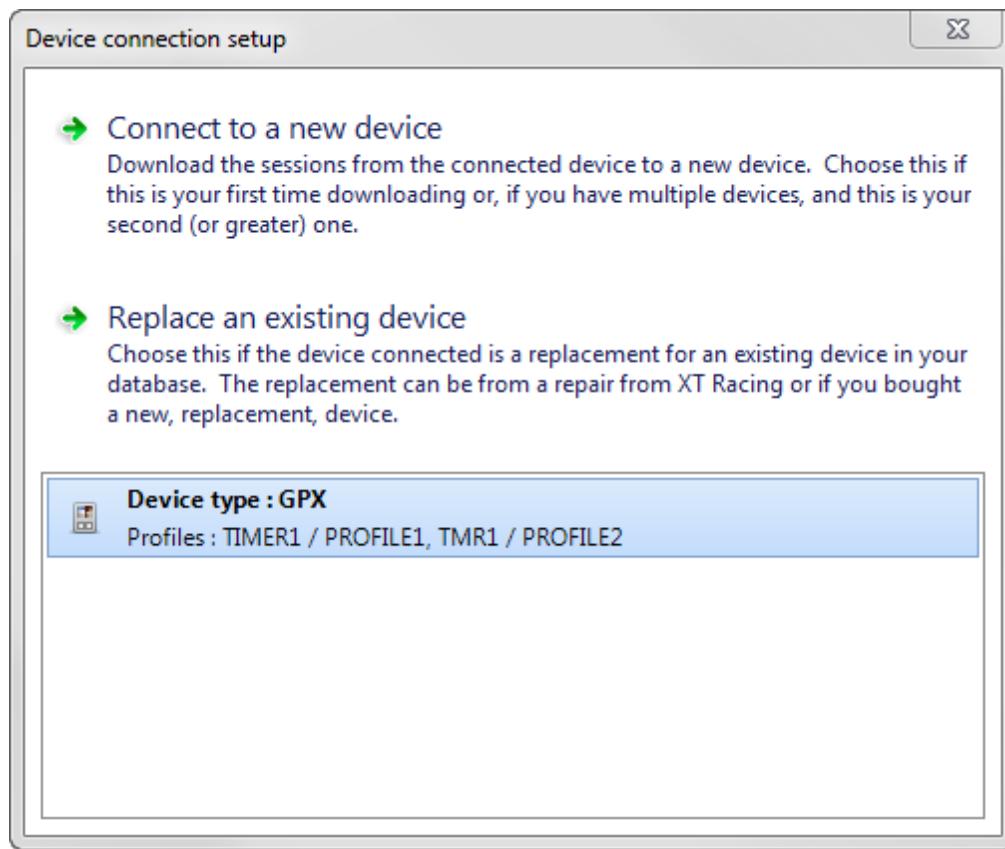
2.1.2 Downloading a device

After the device is connected, the download sessions dialog will appear if there are sessions on the device that need to be downloaded to the database.
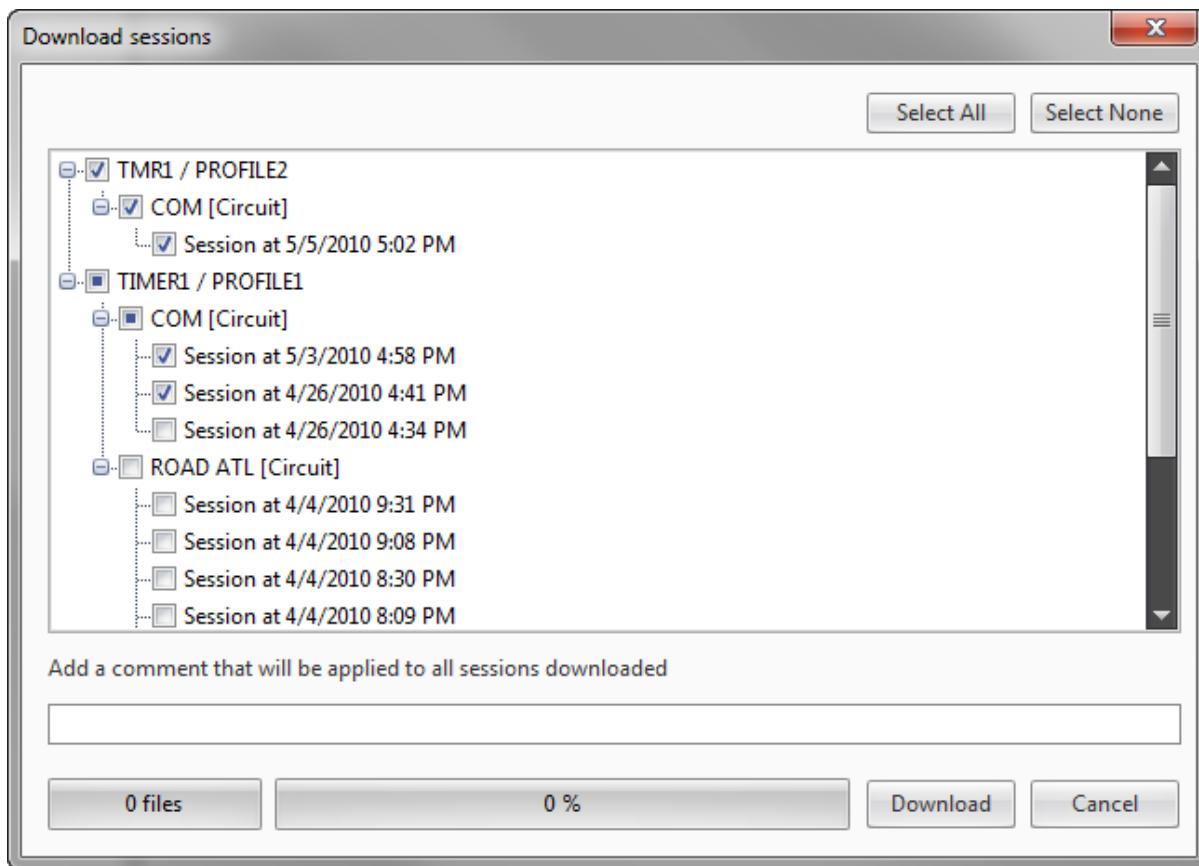
The download sessions dialog shows the profiles that contain sessions to download, the tracks and the sessions themselves. Simply click on each one to select the sessions you want to download or choose **Select All** for a quick way to download everything. If you want to attach a comment to the downloaded sessions then enter it into the comment text box and the comment will be added to all of the sessions downloaded at that time.

When you are ready click **Download** and the process will begin. Each file will move the progress bar as it downloads. When the progress bar reaches 100% XTStudio will compute some additional internal information so a slight pause at the end of each file is expected.

2.1.3 Importing GPStudio databases

The GPStudio database that contains your old session can be imported into XTStudio. To start the import process choose **Home -> Import database.**
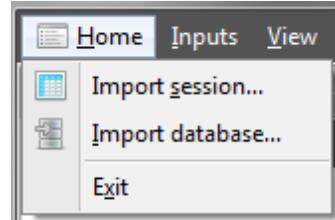
Next, the import database wizard will appear. On this first page, simply click the button that says

Open database file and choose the old gpstudio.dat file from the file dialog (usually in My Document\GPStudio).
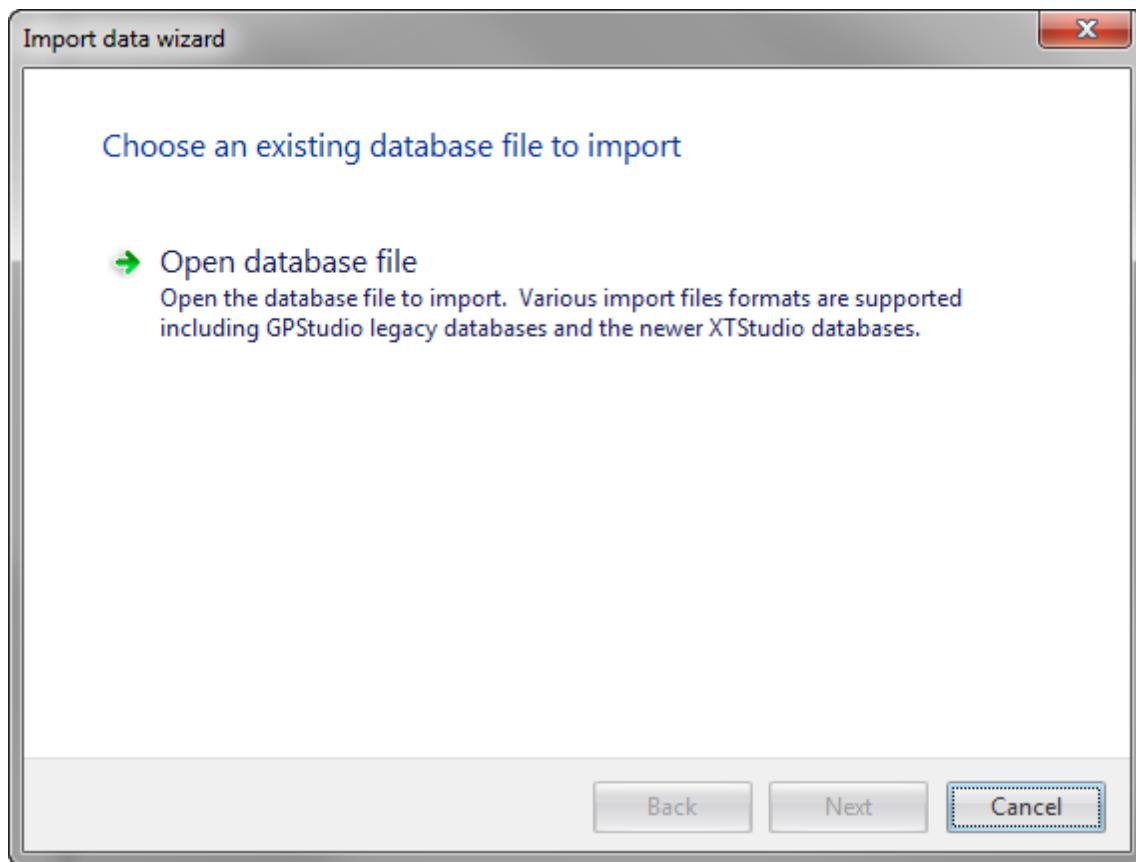
After XTStudio successfully detects the data file as a GPStudio database you can click **Next** to specify the destination profile to import the sessions.
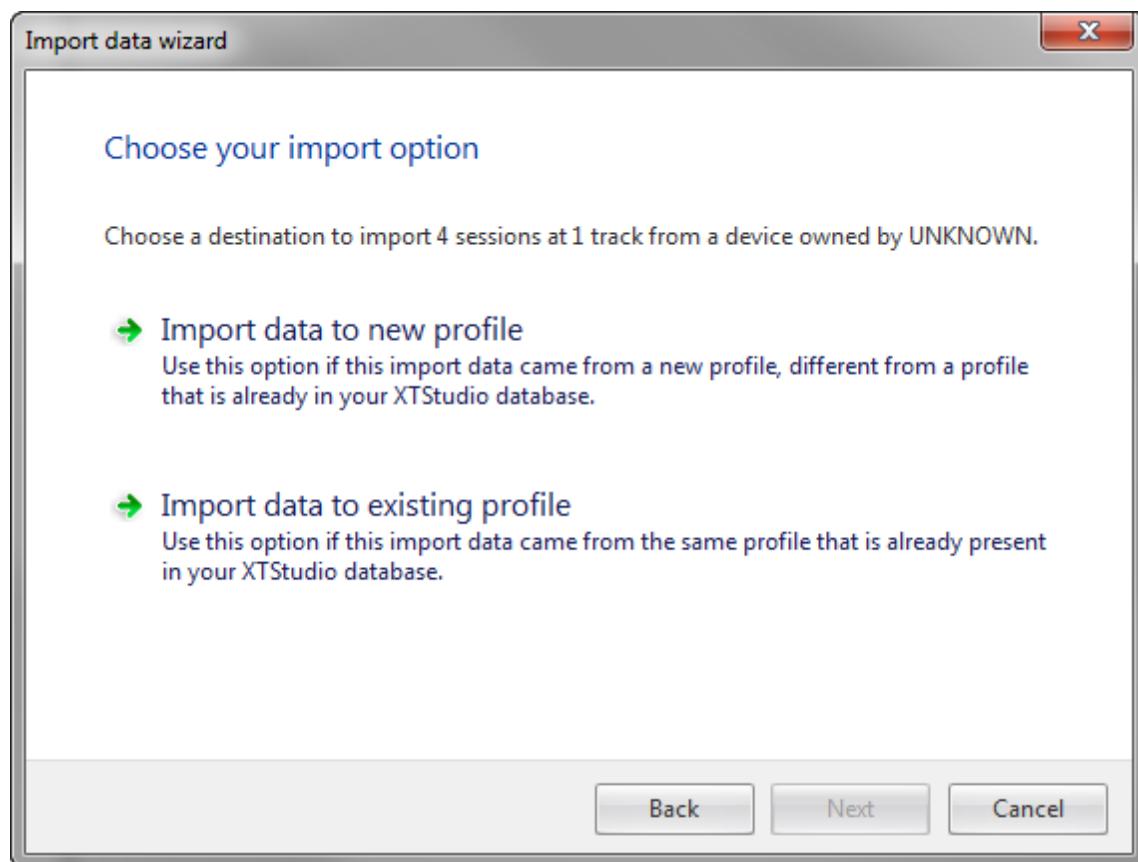
If there are existing profiles already present in XTStudio then you can attach the imported sessions to that profile by choosing **Import data to existing profile.** If there are no profiles present in the XTStudio database or you want to create a new profile for the imported sessions then choose **Import data into new profile**. If you choose to import the data into an existing profile then you will be prompted for the profile to add the sessions to. Once the profile is selected (new or existing), the preview page will appear that tells you what is going to be imported. Clicking **Next** will start the import.
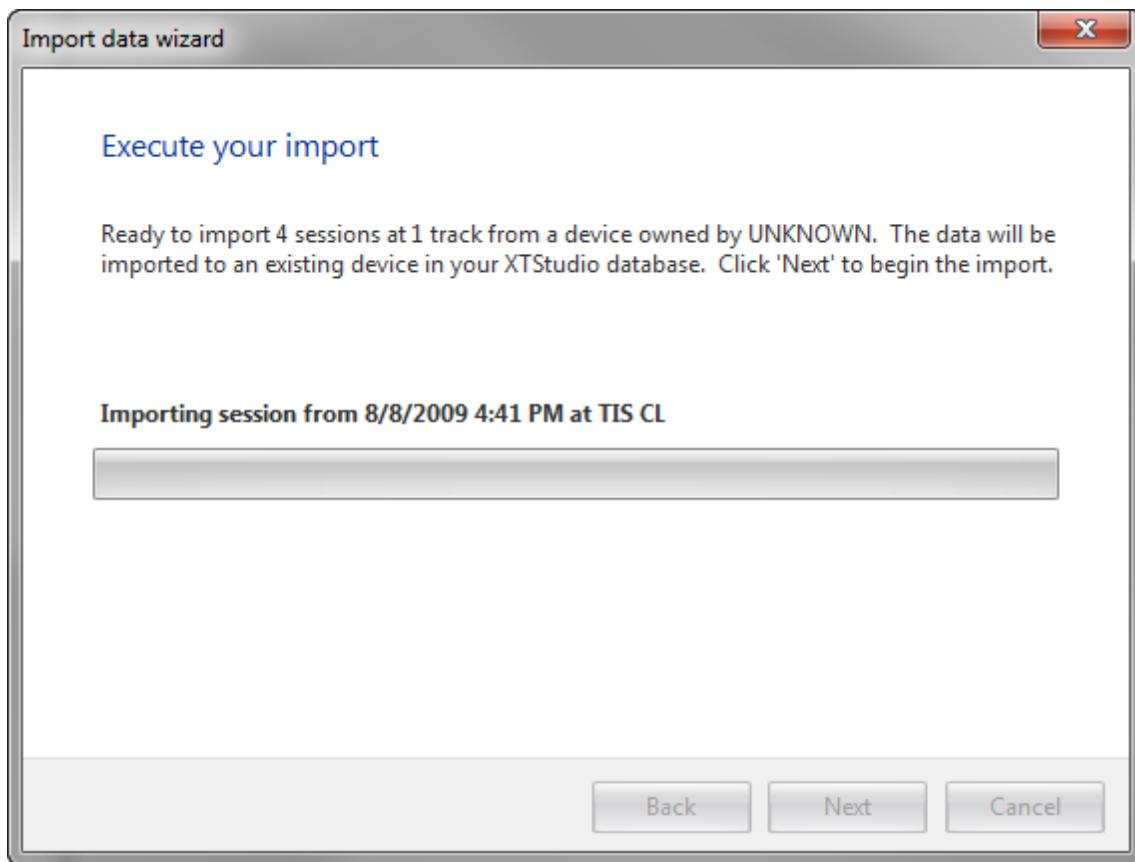
Once the import is complete all of the sessions will appear in the session tree under the new (or existing) profile.

2.1.4   Importing your friend's sessions

XTStudio allows you to share sessions with your friends. By exporting sessions from your database and then emailing or posting them to a forum, your friends can then import the session into their database and compare all of the available data.

To export a session right-click on the session (not a lap) in the tree and choose **Export session for XTStudio**. A save file dialog will allow you to specify where to save the session.
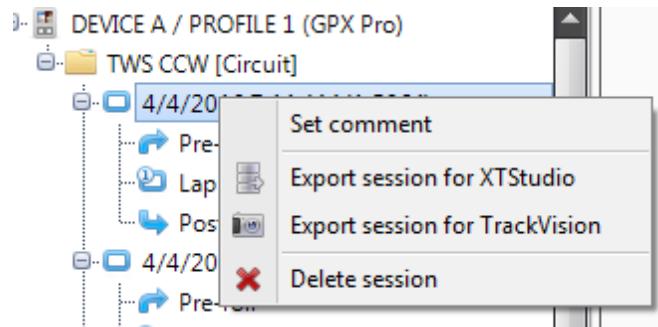
To import a session that someone sent you, you can either double-click on the file from Windows Explorer or if XTStudio is already open then you can use the menu item **Home -> Import session**. An open file dialog will appear. Browse to the received file and click open and the session will be imported and be available from the session tree.
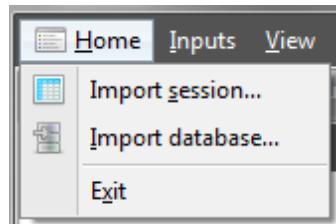
2.2   Database sessions

XTStudio maintains a database of all of your GPX Pro sessions that you download. Even if you need to remove sessions from the GPX Pro because you are running out of memory, once you download them into XTStudio, you will have them forever.

Sessions in XTStudio are stored by the track name, and the date the session took place. To make sure that the date and time of the session is accurate it is important to set the local time of the GPX Pro unit correctly for the track you are racing at so the date/time offset will be correct when you download the session into XTStudio.

2.2.1   Session tree

The session management bar is the central database for storing your racing sessions. All your devices (and profiles) will be present in the session tree. And under each profile the the track name will appear with the type of racing mode the track is for (circuit or point-to-point). In addition, any drag sessions you have run will appear in a folder by themselves.
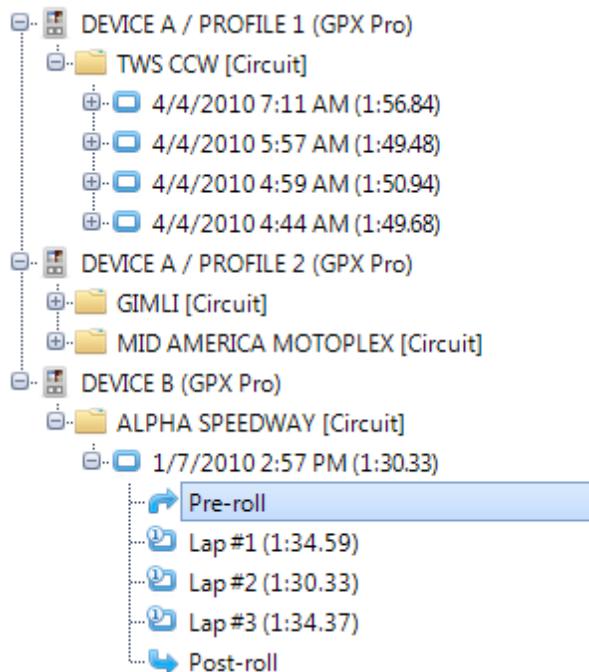
Circuit sessions

For circuit tracks, each session you have raced will be displayed under the track name, and under each session there will be an entry for each lap in that session. In addition to the laps for the session there are two entries for pre-roll and post-roll. These are partial laps that occur before the start/finish line and after the last lap. The post roll can be useful for analyzing data after a crash or other reason for not completing a race.

Point-to-Point sessions

For point-to-point tracks, each session you have raced will be displayed under the track name. Pre-roll and post-roll sections are also present for these sessions.

Drag sessions

Each drag race that you run will appear under the top-level *Drag* folder, and in the folder corresponding to the type of drag race. For example a 0-30-0 on 02/20/2009 drag session will appear as **Drag > 0-30-0 > 02/20/2009**.

Active Track Map

Once a lap is dragged over to a track map, the session tree will automatically hide all sessions that are not from that same track. This makes it very easy to find a comparison lap since there will be less items in the tree. To restore the view to all session simply remove all active laps from the track map screen or create a new track map window with **Window -> Add Track Map**.

2.2.2 Session management

Items in the session tree can be right-clicked on to activate the options for that item. Each item in the session tree will have different options in the menu depending on what is available for that item.

Profile Options
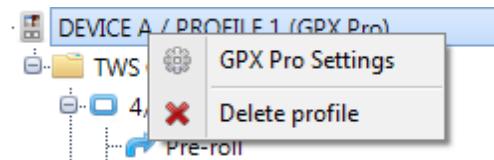
Right clicking on a profile will allow you to access the device settings page for that device (if you have access to that device). The device options page is typically used only by the support staff from XT Racing if you have a problem with your device.

You can also delete a profile and all of its sessions by choosing "Delete Profile"

Session Options
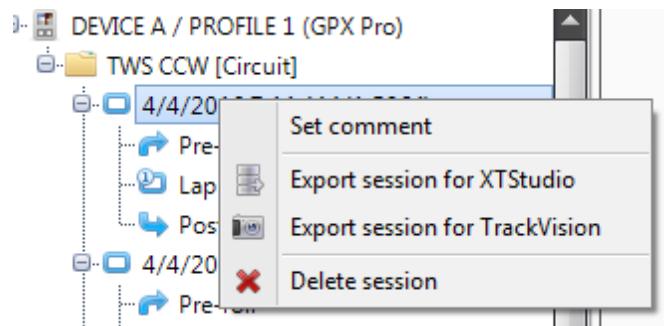
Right clicking on a session will allow you to access the session options.

- *Set comment* - this allows you to set or change the comment associated with a session
- *Export session for XTStudio* - this allows you to export your session to give to your friends so that they can compare their information with your's.
- *Export session for TrackVision* - this allows you to export your session for use with TrackVision software to synchronize your data with a video
- *Delete session* - this allows you to delete a session from your database

Lap Options
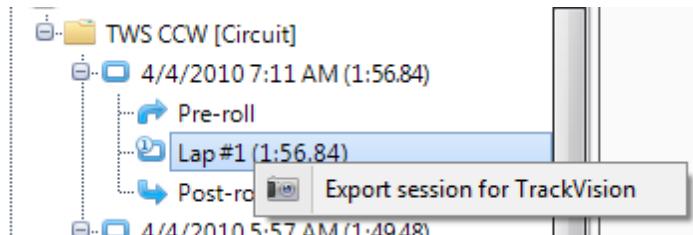
Right clicking on a session will allow you to access the session options.

- *Export session for TrackVision* - this allows you to export your session for use with TrackVision software to synchronize your data with a video

2.2.3   Track filter

The session track filter allows you to hide certain tracks from the session tree without deleting them from your sessions database. To start filtering out tracks, click on the track filter menu item at the top of the session bar.

Track filter   Date filter

You can then use the options listed to add and remove tracks from display. **Select All** will select all the tracks to become visible, and **Select None** will hide all of your tracks. In addition to these global changes, each track can be individually hidden or shown by clicking on the track name.

Select All

Select None

☑ 9N P2P

9N TO FRYS

☑ 9N TO HOME

☑ 9N2

ALPHA SPEEDWAY

☑ BW CCW

☑ CHAD 110

FRYS TO 9N

☑ HOME TO 9N

☑ MCF

☑ Drag
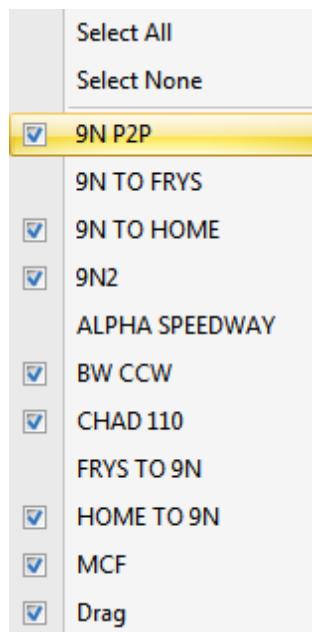
2.2.4   Date filter

The session date filter allows you to hide certain sessions (based on when you ran them) from the session tree without deleting them from your sessions database. To start filtering out sessions, click on the date filter menu item at the top of the session bar.

Track filter   Date filter
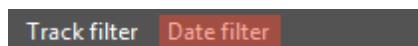
You can then use the options listed to start filtering what is displayed in the session tree by the date of the session. Each of the items listed will filter out any sessions that are not within the date option selected. The **Custom** item will allow you to create a custom filter state using the **From** and **To** entries. To change the dates in the **From** and **To** areas, just click on the down arrow

and choose the date you want, or just type the date into the box.

	Today
	This week
	This month
	This year
☑	All
	Custom
	From 3/23/2009 ▼
	To 3/25/2009 ▼
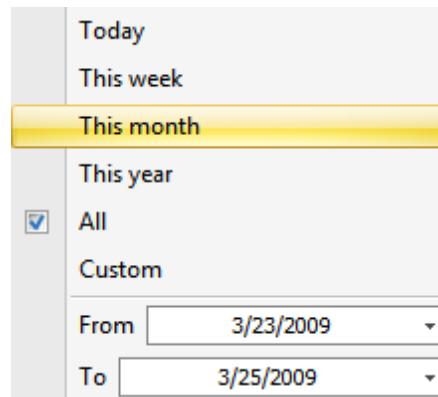
2.3   Input configuration

All data channels can be configured through the **Inputs** menu on the main menu. All of the inputs found in the XTStudio database will be displayed here. Each input has a submenu that has the configuration options for that input.

Inputs	View	Window	Help
Acceleration Latitude	▶
Acceleration Longitude	▶
Altitude	▶
Average DB	▶
Course	▶
Distance	▶
EHPE	▶
Gear	▶
Latitude	▶
Longitude	▶
Number of satellites	▶
Quality of service	▶
RPM	▶
Speed	▶
TPS	▶
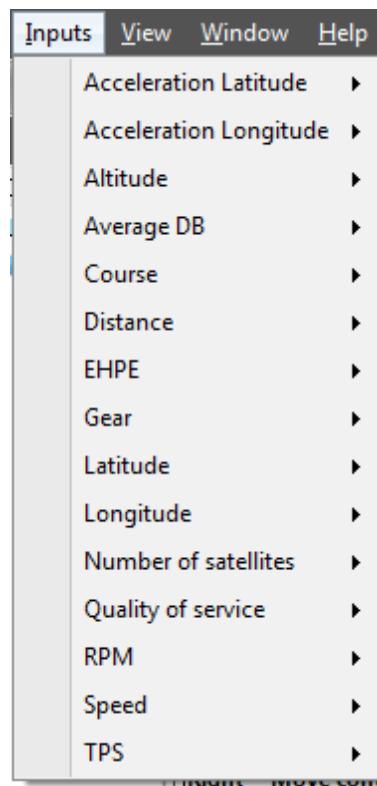
2.3.1   Input range

With the input menu, the minimum value and maximum value of a channel can be forced to specific values. These minimum and maximum values are used throughout the system in all graphs and gauges.

The inputs can be automatically set to the full range by clicking on the **Use full input range** option. By turning this option off you will have access to the number boxes that will allow you to specify the minimum and maximum value for the input.
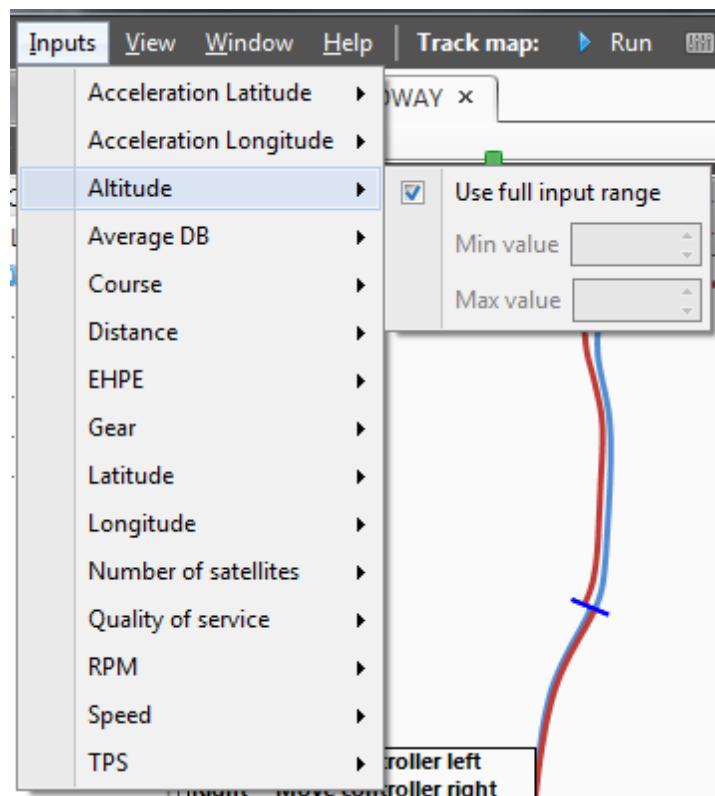
2.4   Analyzing sessions

The main feature of XTStudio is the analysis of your sessions. Analysis of laps or sessions is done via the five major analysis components of XTStudio.

- **Controller bar**
- **Track map**
- **Data bar**
- **Graph bar**
- **Gauge bar**

2.4.1   Track map

The track map is the main window feature in XTStudio. It display the track map for all of the current comparison items and contains the track bar which is used to control the active location for the gauge bar, data bar and graph bars. There can be multiple track maps open at the same time via the main tabbed interface.

Multiple track maps as tab items

Track maps can be added by choosing Window -> Add Track Map.

Add another track map window
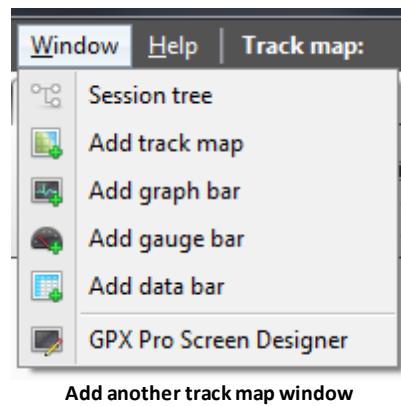
2.4.1.1 Overview

To start your analysis, simply drag (or double-click on it) a lap or session from the session tree to the track map, and that item will be added to the comparison. Each new item will be added to the controller bar in a specific color, and that color is used throughout XTStudio to indicate that the data, track map, graph or gauge needle belongs to that lap.

The track map controller bar appears at the top of the track map. It maps the length of the track from start to finish as a line. The markers that appear on the line are the split lines and the times for each split section are displayed below for each of the color-coded laps.
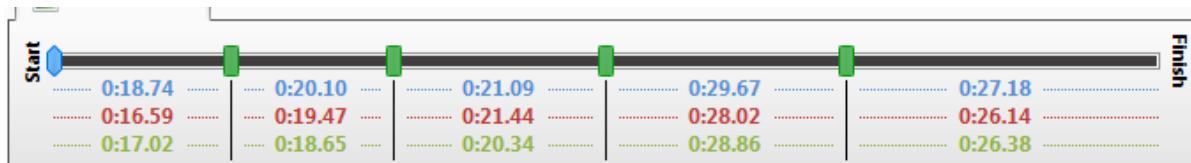
The above picture is comparing three laps from the same circuit session. The track has 5 splits as indicated by the green rectangles. The current location is shown with the blue marker.

The active sessions are managed through the controller menu which can be accessed on the main menu bar under the controller item or by right-clicking on the track map.

Controller menu access from right-click
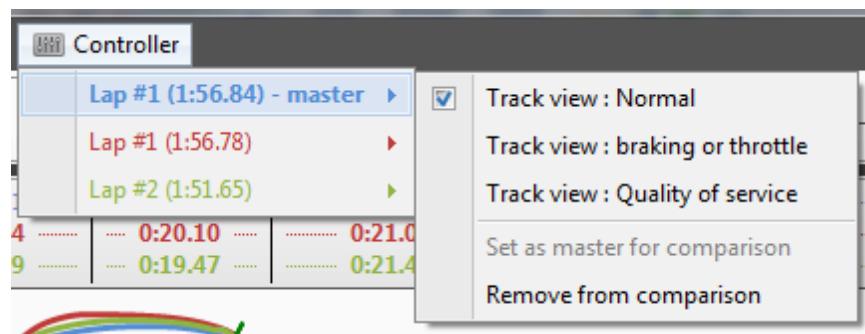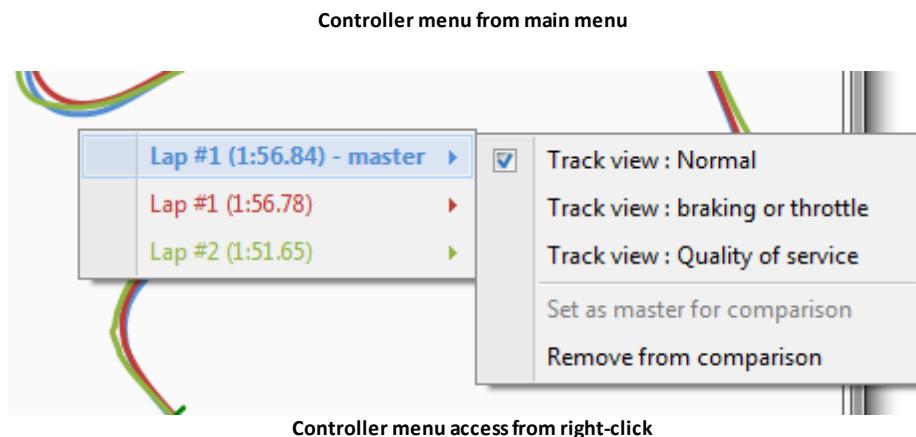
Track view items are used to tell how to draw the track map:

- *Normal* mode just displays the track map in the corresponding comparison item color.
- *GPS quality of service* displays a varying color from red (0%) to green (100%). This display can show you areas of the track where your GPS signal quality is low. A low signal quality could mean that you need the GPX Pro external antenna.
- *TPS (or another DAQ channel name)* displays the DAQ channel value from red (0%) to green (100%). Any analog channel that is calibrated as a 0% to 100% input can be displayed using this mode. (Only available with the DAQ channel connected and correctly configured)
- *Braking or throttle* displays red when you are decelerating and green when you are accelerating. This display is useful when you want to see where on the track you got on the gas after a turn. (Only available with acceleration calibrated and capturing).

The **Set as master for comparison** item sets the master lap for the comparison. The master lap is used when you want to set your graphmodes in *Graph delta to master* mode. This item will set the selected comparison item to the master. The master comparison item is indicated with bold, underlined text in the controller bar item box.

The **Remove from comparison** will remove the the item from comparison.

2.4.1.2   Moving

The controller bar holds the current system location for all of the display of gauges, graphs and track maps. The track bar at the top of the controller bar shows where you are with respect to the start and end of the items. You can drag the handle right or left to move the system location.
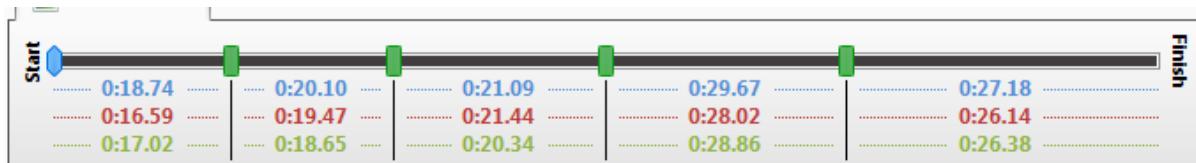
In addition to dragging the track bar with the mouse to move "time", you can use the keyboard shortcuts Left and Right keys, if you hold Ctrl, Alt or Shift while pressing the Left or Right key, you can increase or decrease the change step to move through the lap faster or slower. You can also

click on the track map to move the location to the nearest track point.

In addition to the manual ways to move around the track, you can also automatically run the track by clicking the **Play** button in the top menu bar.
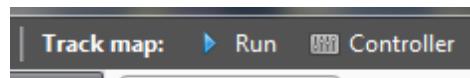
The speed of the playback can be increased or decreased with the **View -> Playback** speed menu item.
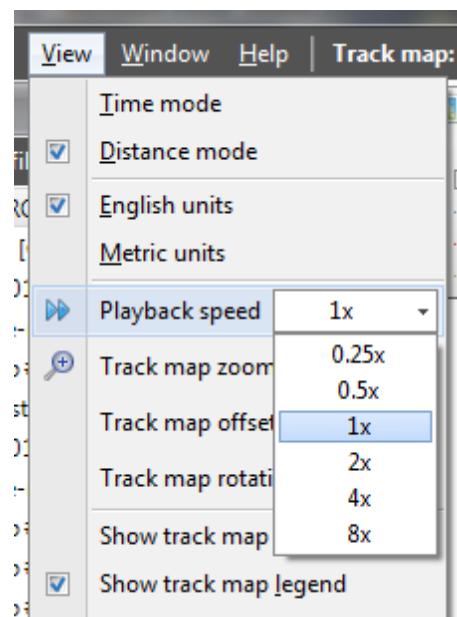
2.4.2   Track map

The track map window is in the tab area of XTStudio and is where the current track map is displayed based on the GPS data collected. The normal track map is displayed in the same color as the comparison item it corresponds to with no track offset displayed. In addition the track map is auto-rotated to fit correctly in the window.

Left	Move controller left
Right	Move controller right
Shift	Step small
Ctrl	Step medium
Alt	Step large
d	Change units to distance
t	Change units to time
k	Clear comparison items
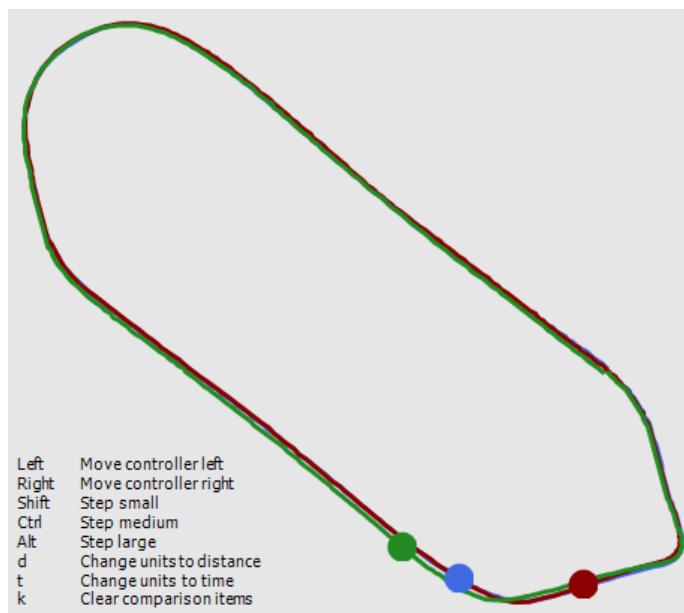
The dots on the track indicate where on the track you were at the given controller distance.

2.4.3   Graph bar

The graph bar will graph data values captured with the GPX Pro. With the ability to plot multiple laps and zoom in and out on the data, the graph bar provides a powerful tool for race analysis. In addition, since you can add multiple graph bars to your XTStudio window, graphing multiple variables at once is possible.

The graph bar is split up into four areas. From left to right the areas are

- Current values display
- Y-axis labels
- Value graph
- Zoom bar
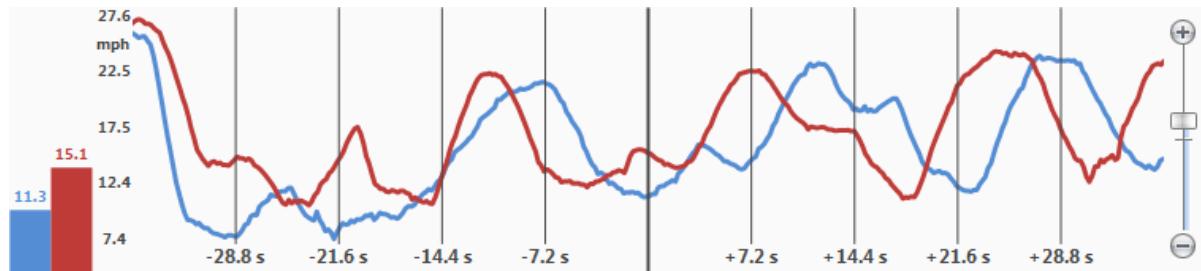
The current value display shows a bar graph with the value of the input at the current system time (or distance). The colors of the bar and the value are displayed in the normal color that corresponds to the item in the comparison.

The y-axis values show the range of the graph and the units of the channel value.

The value graph is the actual graph of the data over time or distance depending on your controller setting. The wider center line shows the current system time. The additional vertical lines span out as a specific time or distance plus or minus from the current time. So, moving the system time either manually or through the replay race function will pan the graph across the center line.

Finally, at the far right is the zoom bar for zooming in and out on the graphed data. Dragging the zoom bar up zooms into the data, while dragging it down will zoom out. It is possible to zoom all the way out so that the entire session is visible in one view.

Graph bars can be added to the screen through the **Window -> Add graph bar** option in the system settings menu.
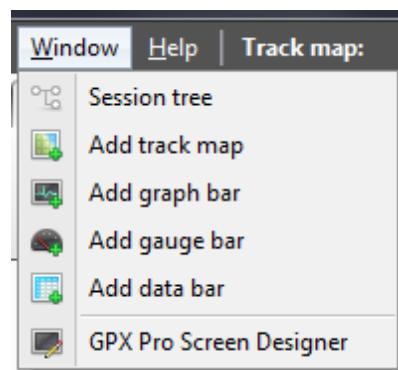
The configuration of the graph can be access from the main menu bar or by right clicking on the graph window.
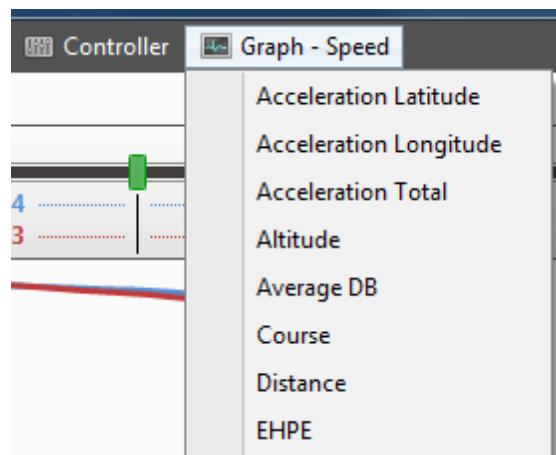
2.4.3.1   Input

The first set of items available from the graph bar settings menu are which input to graph. The list available to you will vary depending on how you have set up your data acquisition inputs. The only data value that will always be available is Speed since that is provided by the GPS module.

All other data acquisition will be listed; simply click on one of them to change the current graph

input. If you have acceleration turned on and calibrated, then the acceleration data will appear as two entries in the list.

- *Accel lat* - the latitudinal acceleration, which is the acceleration to the right or left of the direction you were traveling; in other words, this is the turning acceleration
- *Accel long* - the longitudinal acceleration, which is the acceleration in the direction you were traveling; in other words, this is the braking or throttle acceleration

Acceleration Latitude
Acceleration Longitude
Acceleration Total
Altitude
Average DB
Course
Distance
EHPE
Latitude
Longitude
Number of satellites
Quality of service
RPM
☑ Speed
TPS
Show gear overlay
Show y-axis grid
☑ Show value bars
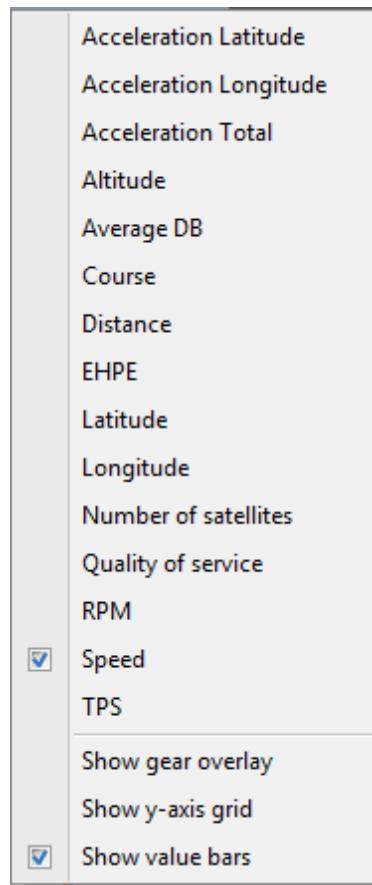
2.4.3.2   Gear overlay

If you have a data channel calibrated as a gear input or are using the RPM gear ratio calculator then this option will make visible the overlayed gear display. The display of gear is not limited to taking up the whole graph area. It is an overlay that you can turn on while looking at another input, for example RPM. This allows you to analyze your RPM and your gear changes at the same time.
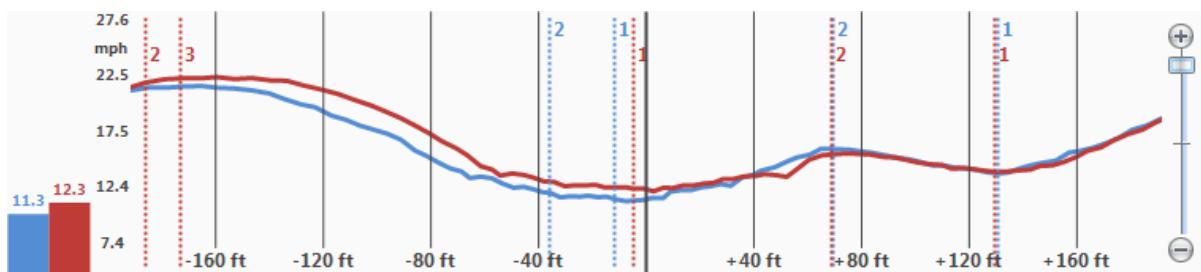
2.4.3.3 Graph delta to master

The graph bar has the ability to graph the data as a delta to the master controller item. Remember, the master controller item is the item that is bold and underlined. The graph will plot the difference between the current item and the master item for the input. This mode provides you a nice overview of the exact places where you were slower on one lap versus another, for example.
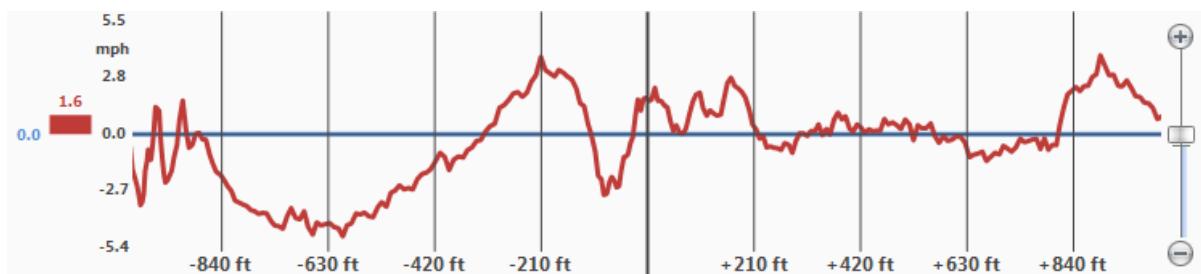
2.4.3.4 Show y-axis grid

Show y-axis grid simple adds y-axis grid lines to the graph to help line up the graph values with the y-axis labels.
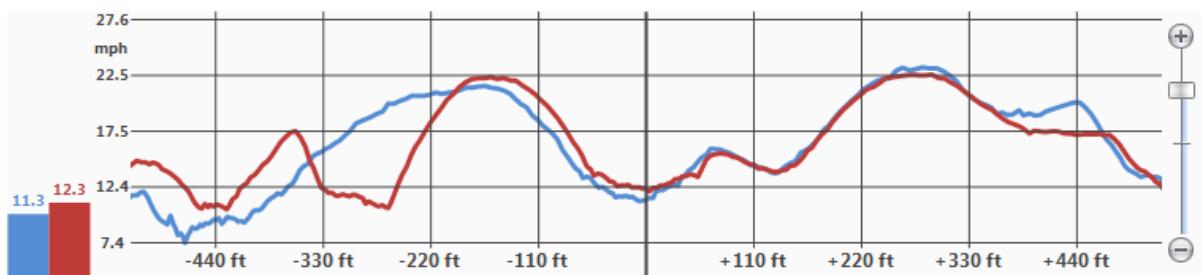
2.4.3.5 Link all chart zooms

The link all chart zooms option (in the **View** menu) is used when you have multiple graph bars open in XTStudio. By choosing this option, all of the graphs in XTStudio will zoom to the same level by moving any one of the graph zoom bars.
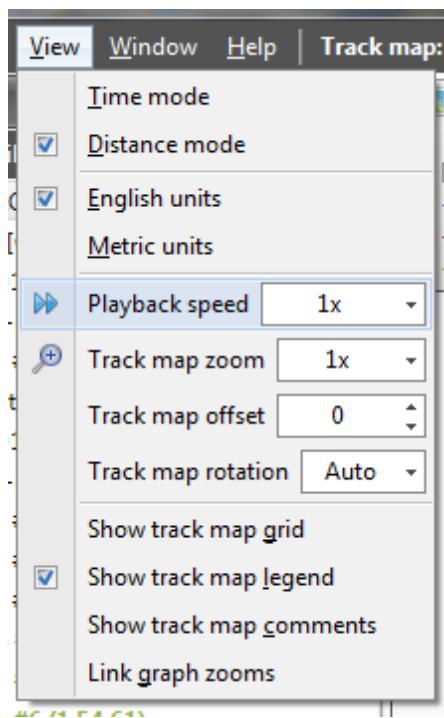
2.4.4 Data bar

The data bar displays detailed information for each comparison item at the current system time. The information includes the current time, current distance, lap time, lap distance. To add a data bar to the screen use the menu item **Window -> Add data bar**

If data acquisition channels are connected and calibrated, then each of the DAQ channels will be displayed. For each channel, the current value, maximum value and current delta value to master comparison item are displayed.

The data bar is useful for pin-pointing to the actual numbers as you use the controller bar to move through your laps.
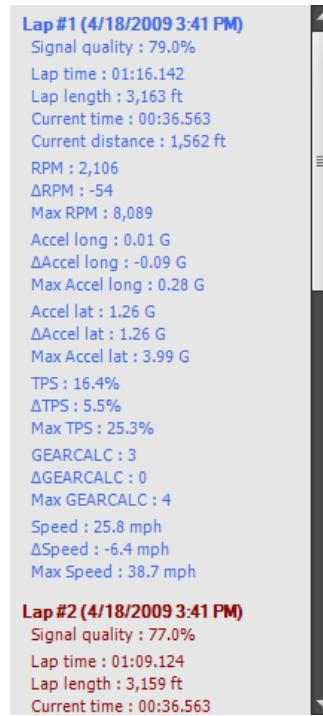
The data bar's display can be customized through the Data menu on the main menu or by right-clicking on the data bar window. Each DAQ channel can be individually turned on and off through this menu to access only the channels you are interested in. In addition the minimum, maximum and delta values can be display by turning on and off those options in the menu.
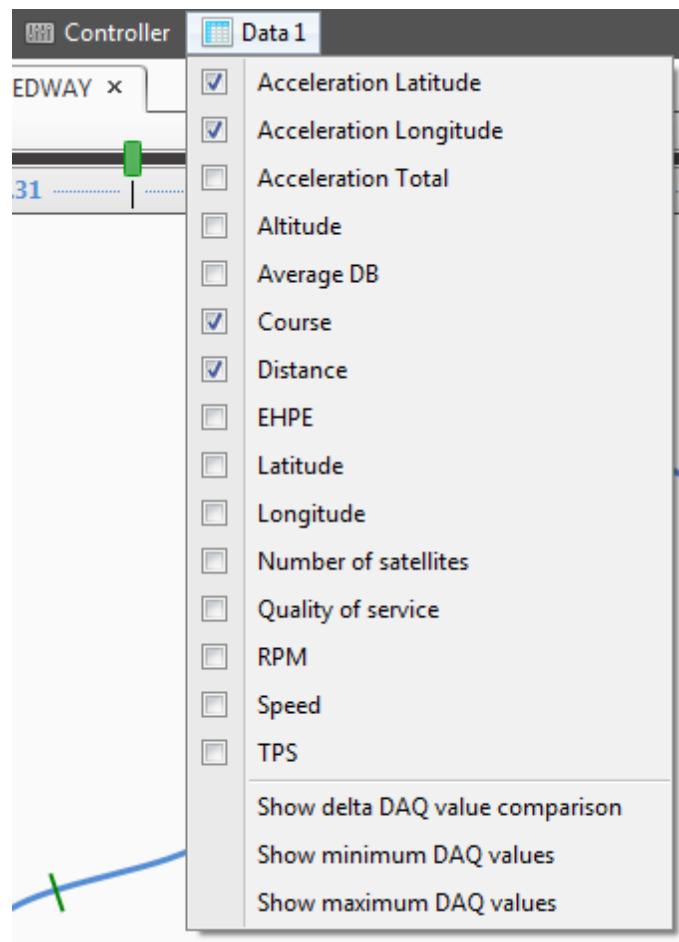
2.4.4.1 Options

The track maps options are found under the **View** menu on the controller bar. There are multiple options available to control the track map display.
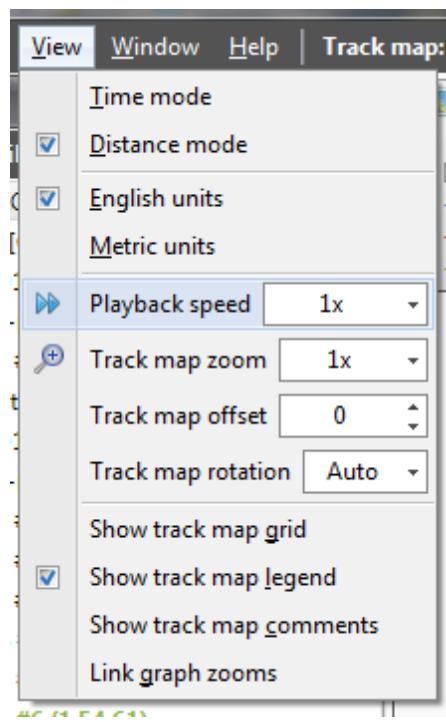
Track zoom

Setting the track zoom allows you to display the zoomed track in the window. By using this option only part of the track around the current system time will be displayed, and as the controller distance changes the display will be panned to keep the dots in the window.
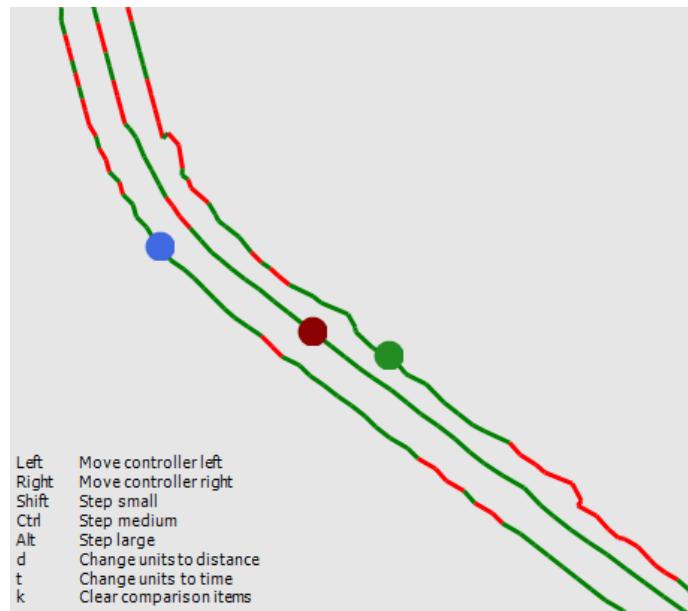
Track offset

The track offset setting is used to separate track maps from displaying on top of each other in the

window. This is used when you want to compare track map views from one lap to another. For example, to compare where on the track you started accelerating in one lap versus another, simply increase the offset to separate the display. For small tracks, or tracks with tight turns to large, an offset can result in a display that overlaps itself, so set the offset carefully for accurate analysis.

Left	Move controller left
Right	Move controller right
Shift	Step small
Ctrl	Step medium
Alt	Step large
d	Change units to distance
t	Change units to time
k	Clear comparison items
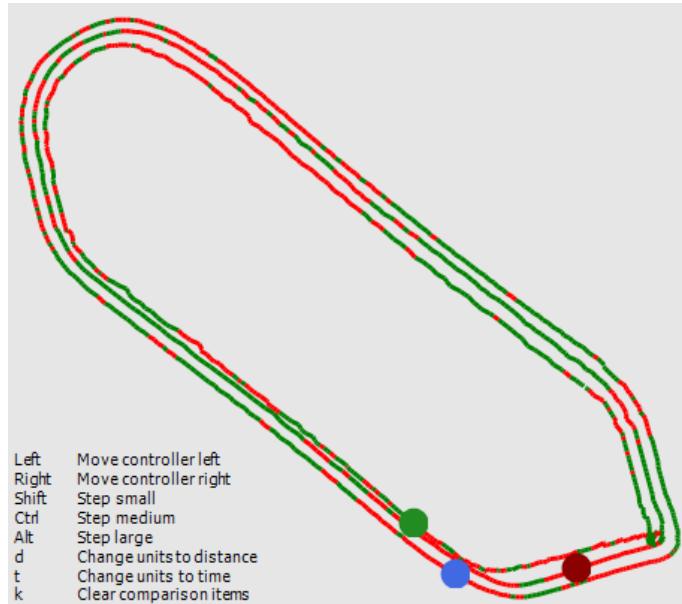
Track rotation

By changing the track rotation from auto to a specific value you can rotate the track to a specific angle.

Show track map grid

This option will display a grid over the track map and indicate the size of the grid squares.
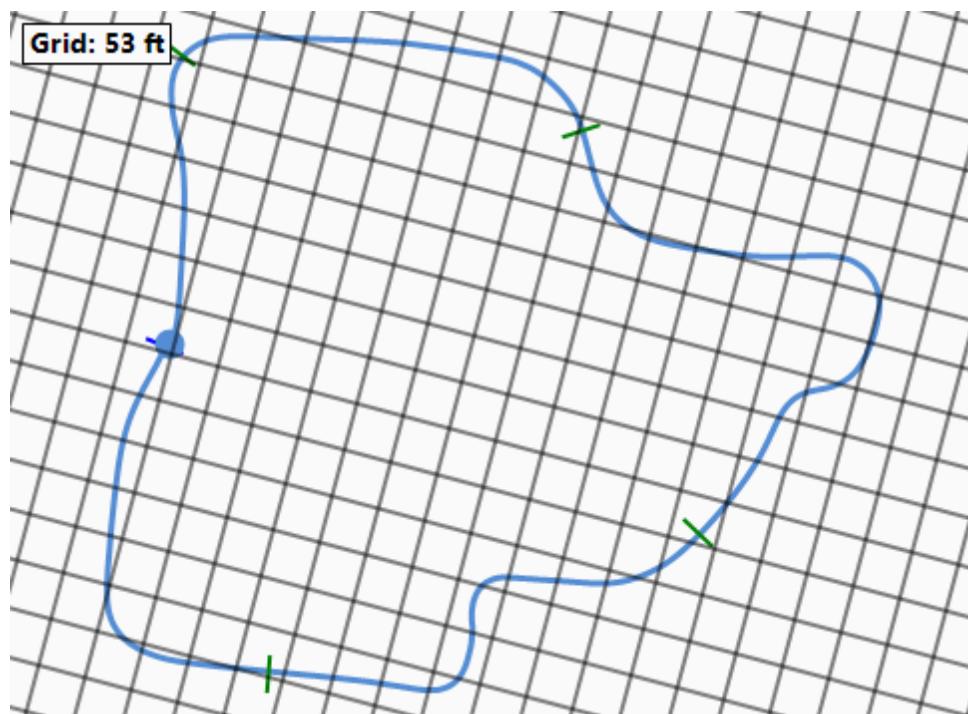
Show track map legend

This option will show the keyboard shortcut keys associated with the track map window.
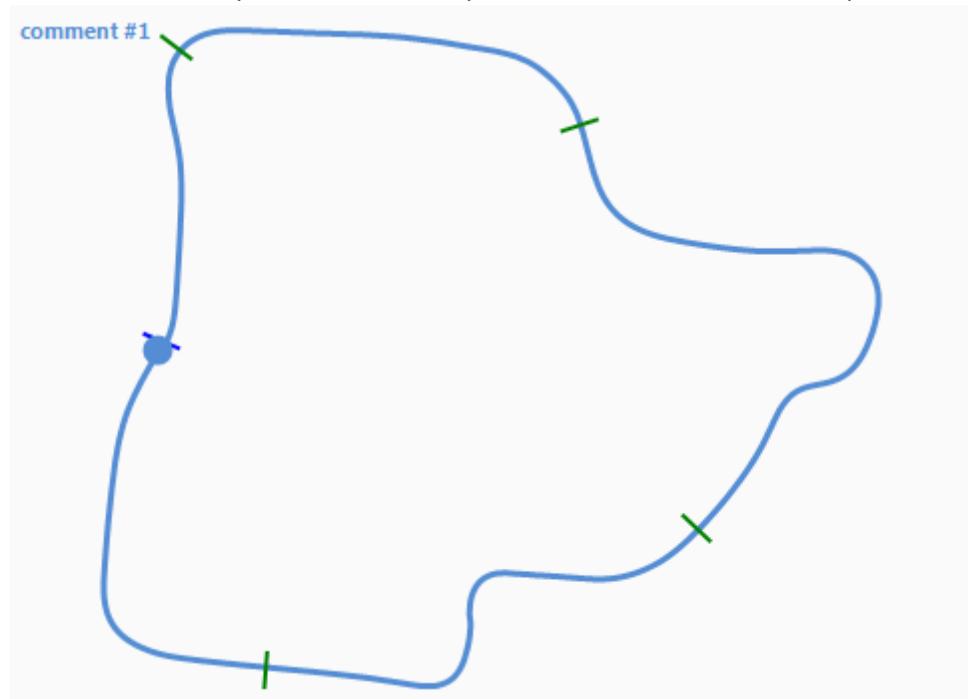
Show track map comments

This option will display the track map comments in the upper left of the track map screen.

Left	Move controller left
Right	Move controller right
Shift	Step small
Ctrl	Step medium
Alt	Step large
d	Change units to distance
t	Change units to time
k	Clear comparison items
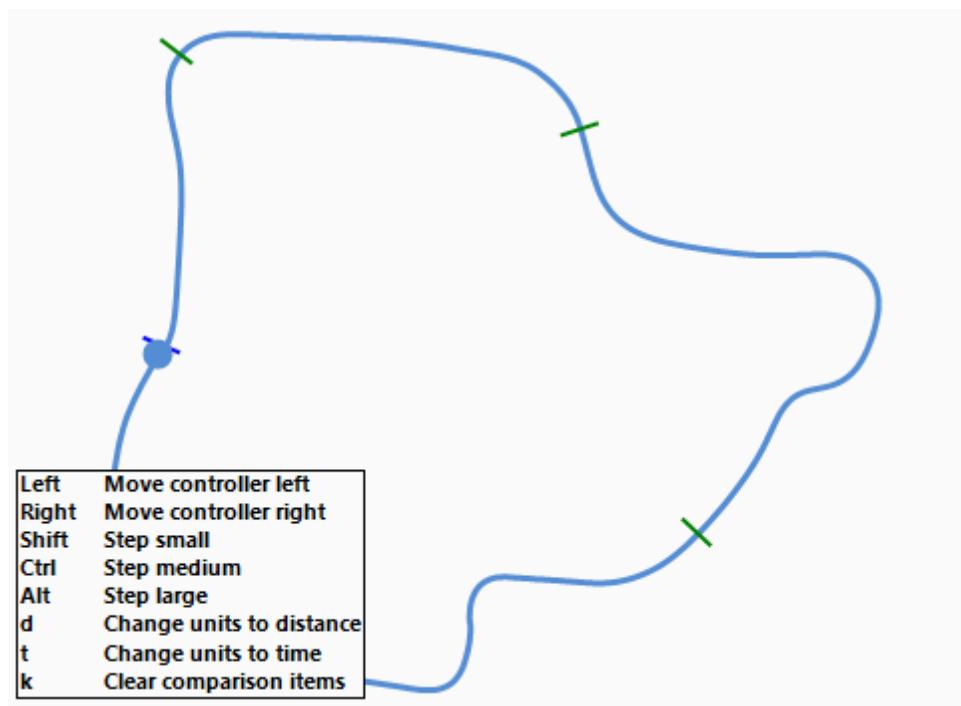
2.4.5 Gauge bar

The gauge bar displays a series of circular gauges where the current data values are shown for a given data channel. Multiple gauge bars can be added to XTStudio and multiple gauges can be added to a single gauge bar.
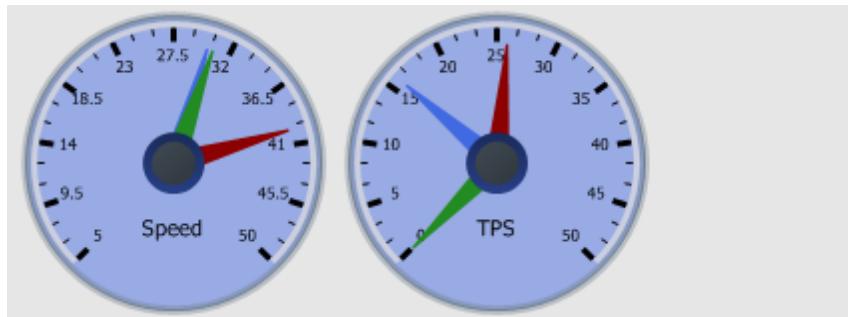
Each gauge will have one needle for each comparison item where, again, the color corresponds to the color in the controller bar. You can add a new gauge to the gauge bar by right-clicking in the blank area to the right or below the gauges.

Add a new gauge
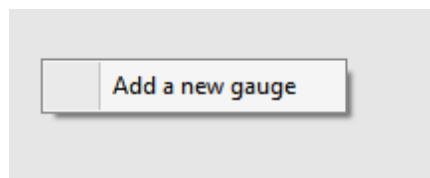
To change the input, move the gauge or remove the gauge from the gauge bar, simply right click

on the gauge and choose the option you want.
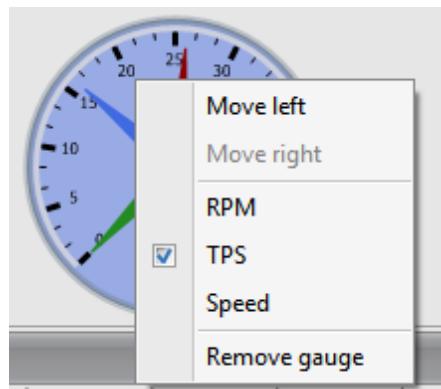
Gauge bars can be added to the screen through the **Window -> Add gauge bar** menu.
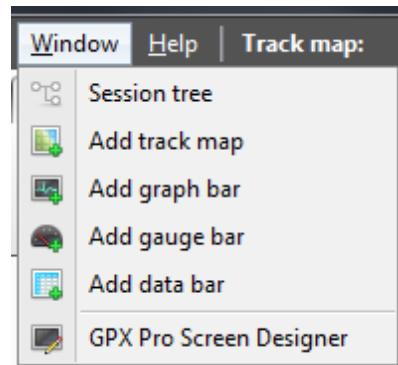
2.5 Designing screens

With XTStudio, you not only have a powerful lap analysis tool but also a way to customize the GPX and truly make it your own. Using the screen designer in XTStudio, you can customize any and all of the GPX screens with your own boxes, lines, data acquisition value... even images! With custom screens for each racing mode (Circuit, Point-to-Point, Drag, Instrument) and for each screen type (Main screen, Session summary, Lap details, Spinner), there are literally infinite ways to make the GPX Pro your own.

2.5.1 Overview

You can access the GPX Pro screen designer by going to **Window > GPX Screen Designer.**
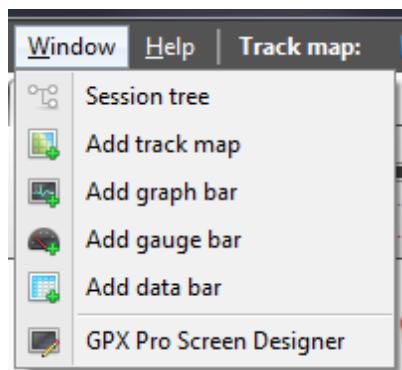
Starting the screen designer for the first time will bring up the designer with no layout file loaded, if you have already started designing screens, then the designer will open the last layout you were editing.
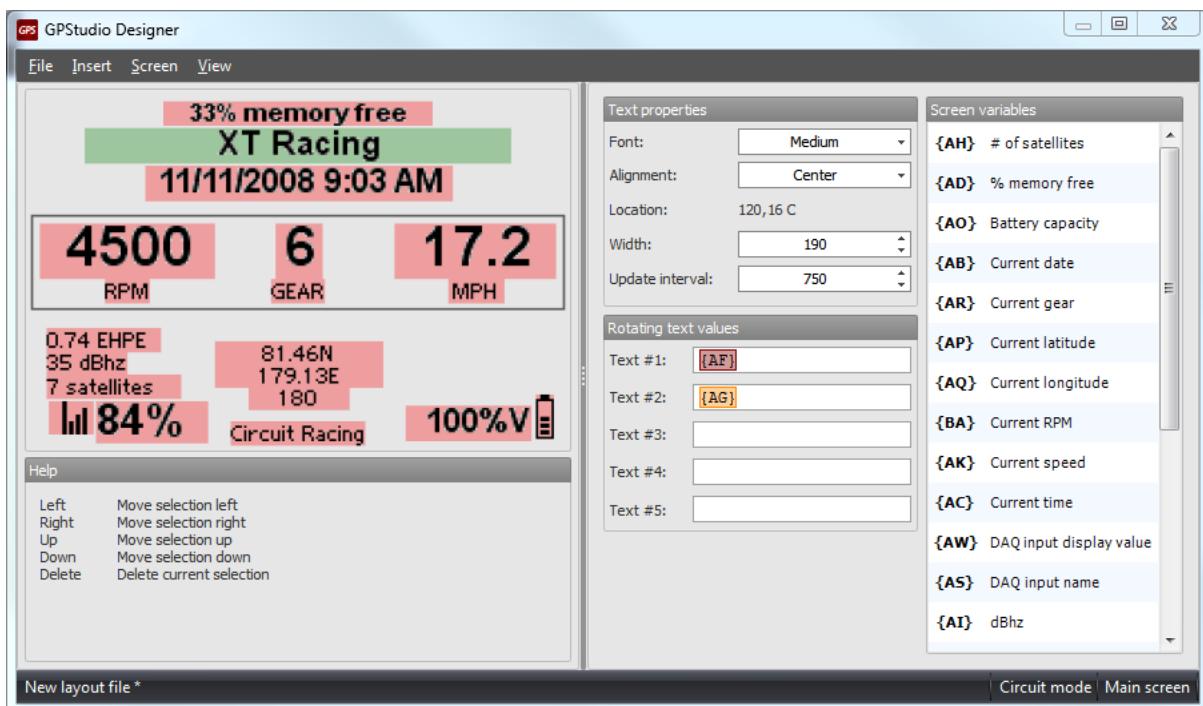
The designer window is split up into two sections, the screen display on the left and the object editor on the right. In addition there is a status bar that tells you the current layout file you are editing (with a star next to it if it has changed) and the active mode and screen you are editing.

In the screen, each object is displayed using a sample text value and a red background that shows how much space the object takes on the screen. If the object is selected, the background changes to green and the object editor on the right changes to give the information about that object. In addition to editing the object's properties, while an object is green, you can use the mouse to drag the item around the screen or use the arrow keys to nudge it.

2.5.2   Menus

The file menu allows you to maintain your layout files. The file menu is also where you can send the opened layout to the GPX Pro (only available if the GPX Pro is currently connected to the computer) or you import certain screens from a friend's layout file.
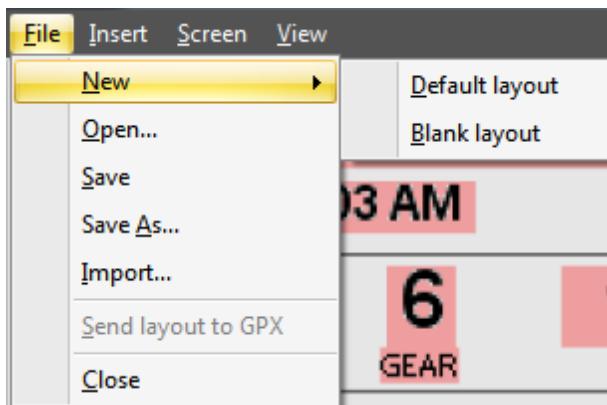
The insert menu allows you to add the object types to the current screen layout.
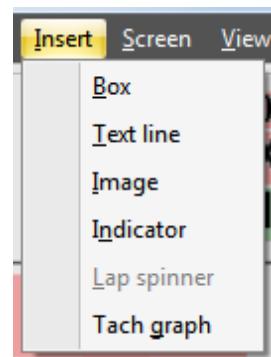
The screen menu is used to switch the active mode or screen type. In addition, it allows you to copy the current screen layout from one mode to another. For example, if you want your point-to-point main screen to be the same as the circuit main screen, then you can choose **Copy current screen to point-to-point mode** while the active screen is the circuit mode main screen.
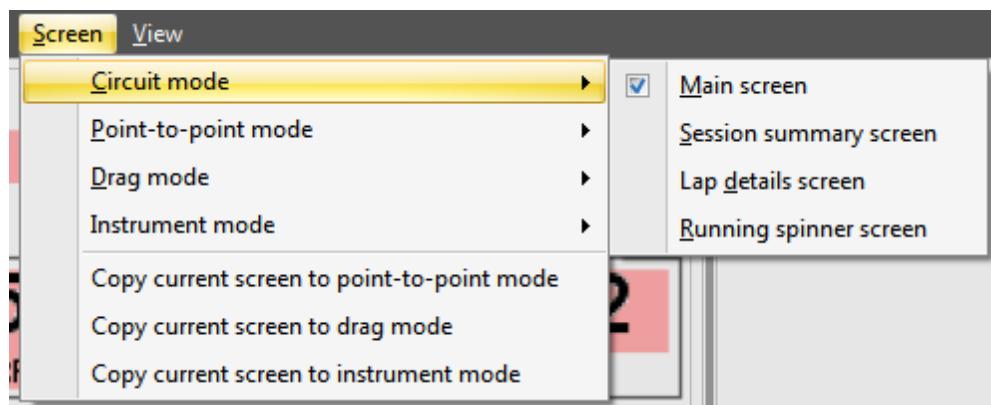
The view menu allows you to switch the display value of the screen from the sample values to the maximum length values. Maximum length value display is used to make sure that your text fields are wide enough to handle all screen variable values.
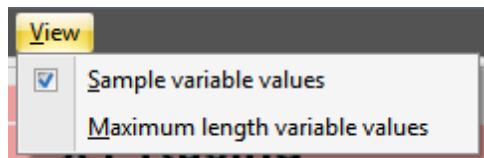
2.5.3 Text objects

The GPX Pro text object is the most powerful object for designing screens. The text object allows you to display all of the data values that are available in the GPX Pro timer.
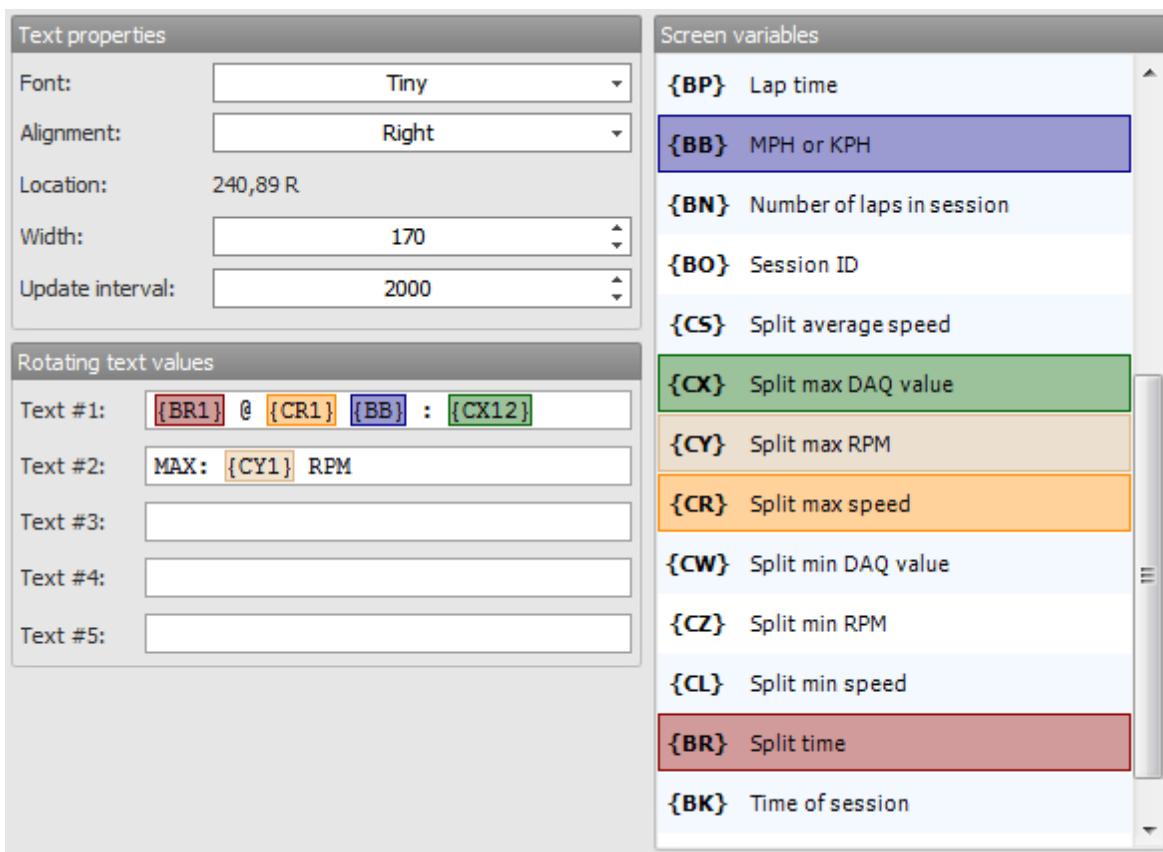
The text object properties editor is divided into three sections. The text layout properties, the text display values and the screen variable list.

The text layout properties defines the font, the alignment of the text within the box, the location of the box, the width of the text box and the update interval of the text fields. The update interval tells the GPX Pro timer how often to update the screen with this text value, or if there are multiple rotating text values then how often to switch between the text values. The update

interval time is specified in milliseconds so 1000 is 1 second, 2000 is 2 seconds, etc.

The rotating text fields specify the values to display in the text box, again if you specify more than one text value then the GPX Pro timer will rotate between the values at the specified update interval. Regular text is entered by just typing in the text you want to display; however, it is the screen variables that really give the text object its power.

A screen variable is a two letter (and up to two number) combination enclosed in curly brackets. This special sequence of characters tells the GPX Pro to insert a screen variable value in the place of the curly bracketed section. The available variables are displayed in the screen variables list. In addition if you have screen variable sequences in the text boxes, then they will get colored according to which variable they match up to like in the above screen shot. This will help you see the link between the text field and the variable.

As an example, the above setup will rotate between the following two values every 2 seconds:

1:12.67 @ 170.7 MPH : 202°F
MAX: 5448 RPM

To insert a screen variable from the list, click in the text box where you want to insert the variable and then double click on the variable from the list, this will insert the curly bracket for you in the text box. Data acquisition values and split time data values have up to two additional digits in the curly bracket. These specify the input to display and the split time to display it for. When you double click on one of these variables, a selector will come up that you can use to specify the DAQ input or the split number or both. If you want to edit an existing curly bracket with DAQ or split values, you can double click on the colored box in the text box and the dialog will reappear. Then you can select a different input or split and designer will update the text variable.

DAQ Variable Selection

- **Input : TPS**
- Input : WATER
- Input : RAW
- Input : SUSPR
- Input : RPM
- Input : RPMIND
- Input : GEARCALC
- Input : ALONG
- Input : ALAT

Split Variable Selection

- **Split #1**
- Split #2
- Split #3
- Split #4
- Split #5
- Split #6
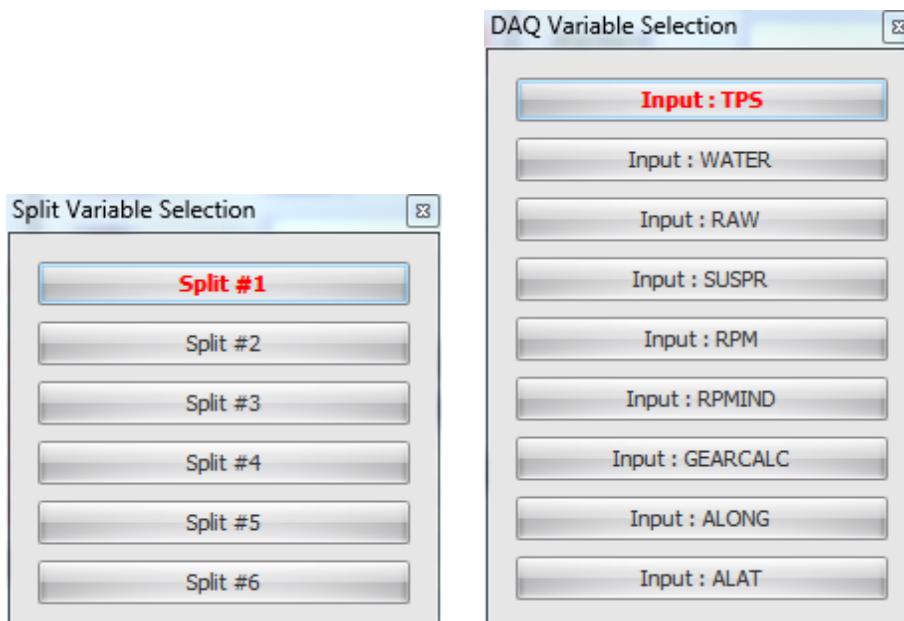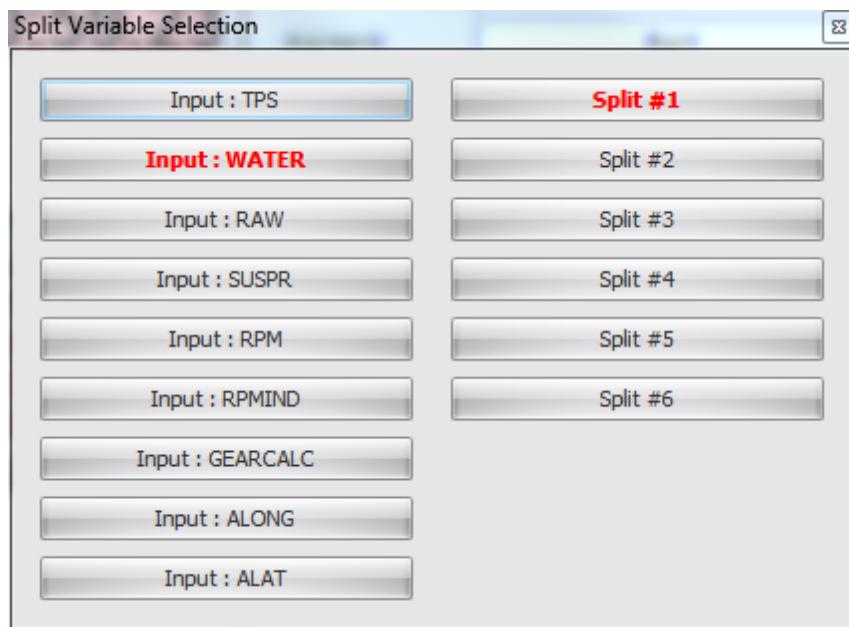
2.5.4   Images

The image object is used to insert an image on your screen. Again, the update interval specifies how fast the image rotates if you specify more than one image.
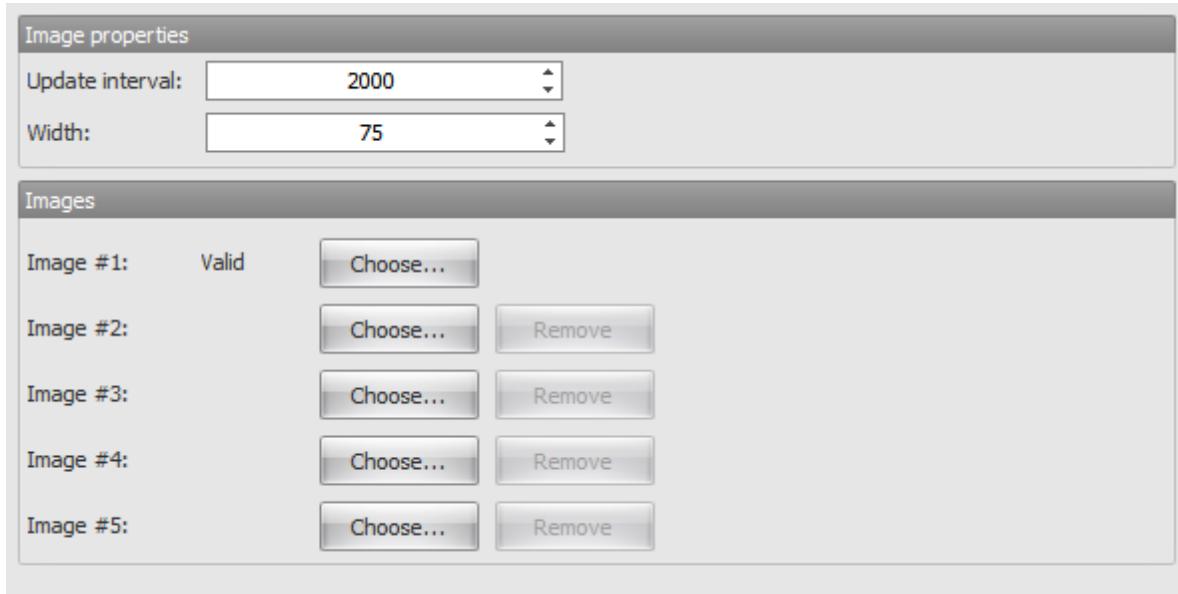
2.5.5   Indicators

There are two indicators available. The battery graphic and the GPS antenna graphic. Simply choose which you want to display.

Indicator properties

Type: Battery

☐ Is horizontal
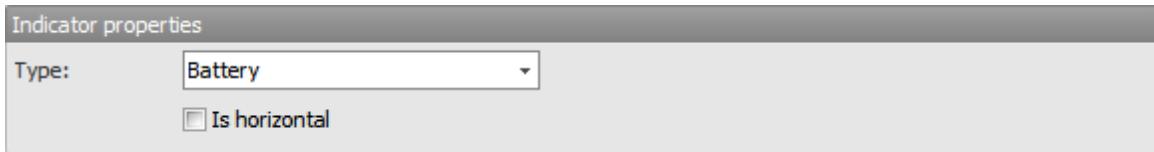
2.5.6 Boxes

The box object is used to draw a box on the screen. You can specify the width, height and thickness of the box. The bar at the bottom is used to control the line color of the box.

Box properties

Location: 1,55

Width: 238

Height: 43

Thickness: 1

Color:

2.5.7 Lap spinner

The lap spinner is the displayed current running lap or race time. There are two sizes of spinners available, large or small.

Spinner properties

Location: 0,110

Size: Large
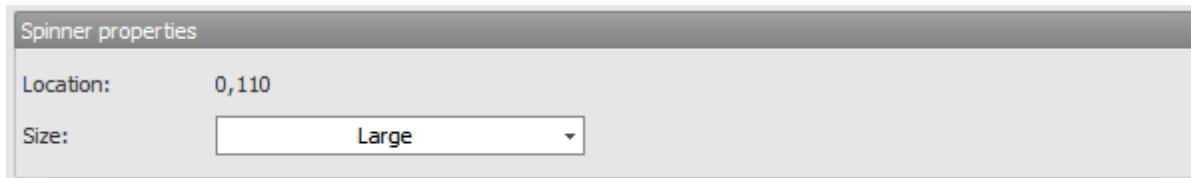
2.5.8 Tachometer graph

The tachometer graph is used to display the tach graph for your current RPM. You can specify the width and height of the graph.

Tach properties

Width: 230

Height: 50

2.6 Windows drivers

The Windows drivers are provided on the XTStudio installation CD and they are also copied to C:\Program Files\XT Racing\XTStudio\Driver after the XTStudio installation is complete. You may also need your original Windows CD when installing the driver.

Windows XP

To begin the installation of the GPX Pro driver on Windows XP simply plug the GPX Pro into your computer's USB port. After the device is connected, the Found New Hardware Wizard will appear.
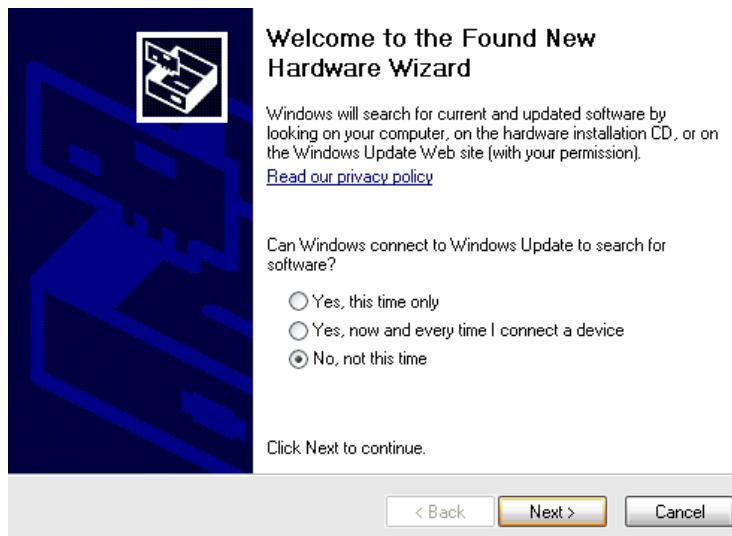
Choose "No, not this time" when the wizard asks you to connect to Windows Update to search for the driver. Then click Next.
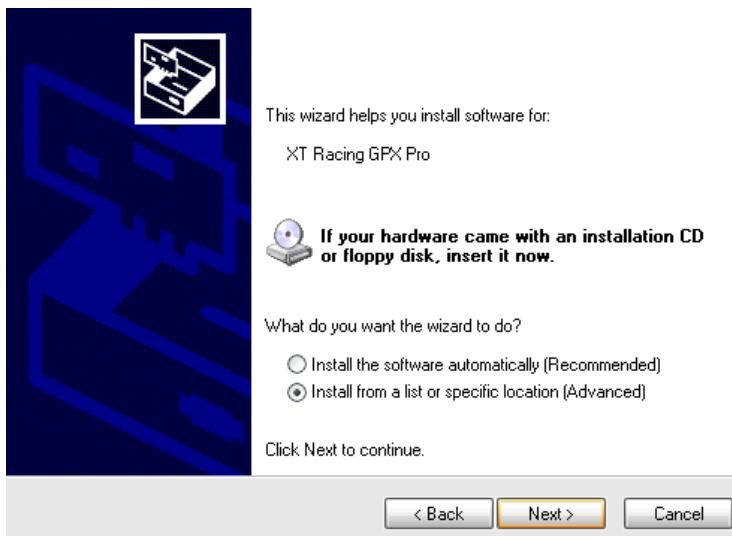
If you have the XTStudio CD inserted, then you can choose "Install software automatically", or if you have already installed XTStudio (and do not have the XTStudio CD inserted) then you should choose "Install from a list or specific location". Then click Next.
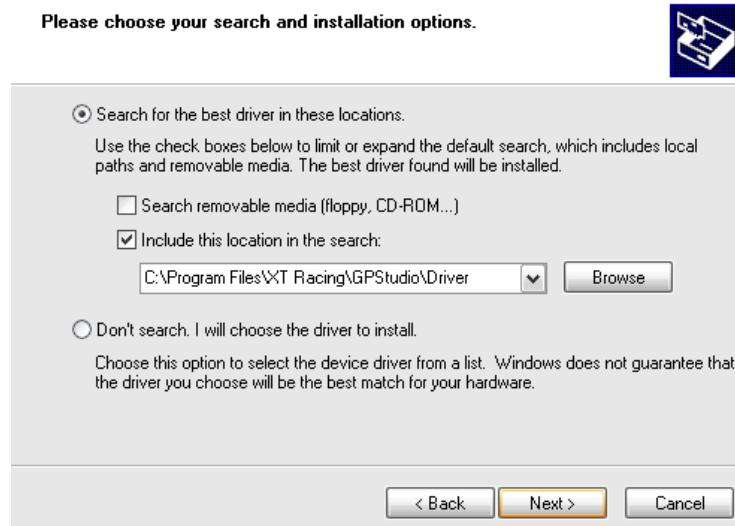
In the "Include this location in the search" box enter "C:\Program Files\XT Racing\XTStudio\Driver". Then click Next. Again, it is possible that you will need to provide the original Windows CD if prompted. After the driver installation is complete, if XTStudio is running it will need to be restarted for the communication to proceed.

Windows Vista

To begin the installation of the GPX Pro driver on Windows Vista simply plug the GPX Pro into your computer's USB port. After the device is connected, the Found New Hardware Wizard will appear.
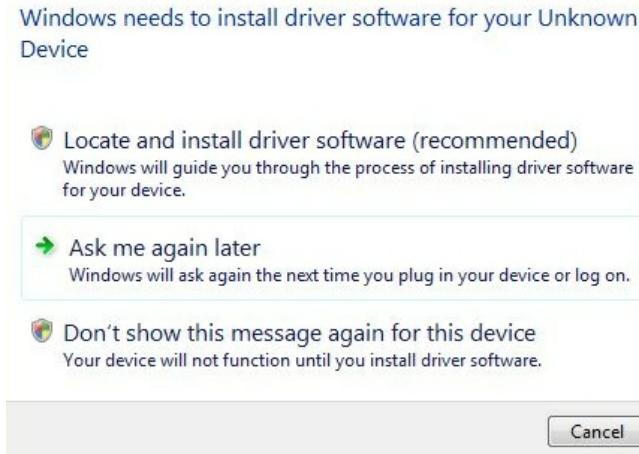
On the Found New Hardware Wizard choose "Located and install driver software". If you have the XTStudio CD inserted then Windows should automatically find and install the driver. If you have already installed XTStudio and do not have the CD inserted, then Windows will say that it couldn't find the driver software.

If this is the case, then choose "Browse my computer for driver software"

In the "Search for driver software in this location" box enter "C:\Program Files\XT Racing\XTStudio\Driver". Then click Next. This will install the GPX Pro driver.

The software for this device has been successfully installed

Windows has finished installing the driver software for this device:

XT Racing GPX

Close